



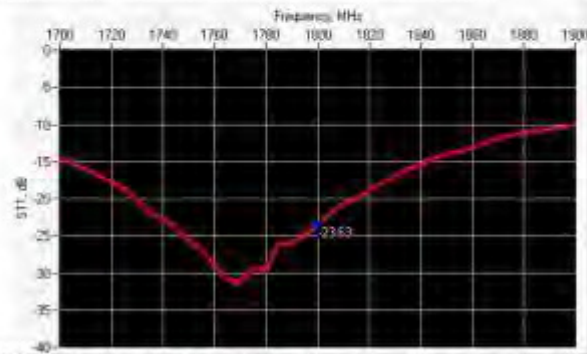
SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.75.10.15.SATTJ.A

10 g	20.1 %
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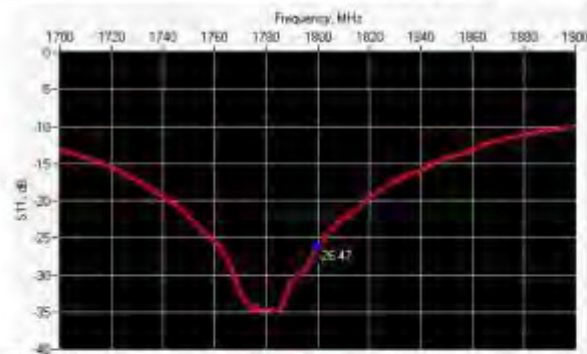
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
1800	-23.63	-20	$45.1 \Omega + 4.0 j\Omega$

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
1800	-26.47	-20	$45.5 \Omega - 0.3 j\Omega$

6.3 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	$420.0 \pm 1 \%$		$250.0 \pm 1 \%$		$6.35 \pm 1 \%$	

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACE-75-10 (3 SARIT) A

450	290.0 ±1 %		166.7 ±1 %		6.35 ±1 %	
750	176.0 ±1 %		100.0 ±1 %		6.35 ±1 %	
835	161.0 ±1 %		89.8 ±1 %		3.6 ±1 %	
900	149.0 ±1 %		83.3 ±1 %		3.6 ±1 %	
1450	89.1 ±1 %		51.7 ±1 %		3.6 ±1 %	
1500	80.5 ±1 %		50.0 ±1 %		3.6 ±1 %	
1640	79.0 ±1 %		45.7 ±1 %		3.6 ±1 %	
1750	75.2 ±1 %		42.8 ±1 %		3.6 ±1 %	
1800	72.0 ±1 %	PASS	41.7 ±1 %	PASS	3.6 ±1 %	PASS
1900	68.0 ±1 %		39.5 ±1 %		3.6 ±1 %	
1950	66.3 ±1 %		38.5 ±1 %		3.6 ±1 %	
2000	64.5 ±1 %		37.5 ±1 %		3.6 ±1 %	
2100	61.0 ±1 %		35.7 ±1 %		3.6 ±1 %	
2300	55.5 ±1 %		32.6 ±1 %		3.6 ±1 %	
2450	51.5 ±1 %		30.4 ±1 %		3.6 ±1 %	
2600	48.5 ±1 %		28.8 ±1 %		3.6 ±1 %	
3000	41.5 ±1 %		25.0 ±1 %		3.6 ±1 %	
3500	37.0 ±1 %		26.4 ±1 %		3.6 ±1 %	
3700	34.7 ±1 %		26.4 ±1 %		3.6 ±1 %	

7 VALIDATION MEASUREMENT

The IEEE Std. 1528, FCC KDBs and CEI/IEC 62209 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

7.1 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε _r)		Conductivity (σ) S/m	
	required	measured	required	measured
300	45.3 ±5 %		0.87 ±5 %	
450	43.5 ±5 %		0.87 ±5 %	
750	41.9 ±5 %		0.88 ±5 %	
835	41.5 ±5 %		0.90 ±5 %	
900	41.5 ±5 %		0.97 ±5 %	
1450	40.5 ±5 %		1.20 ±5 %	
1500	40.4 ±5 %		1.23 ±5 %	
1640	40.2 ±5 %		1.31 ±5 %	
1750	40.1 ±5 %		1.37 ±5 %	

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Rev: ACB-75.10 (3 SARIT) A

1800	40.0 ±5 %	PASS	1.40 ±5 %	PASS
1900	40.0 ±5 %		1.40 ±5 %	
1950	40.0 ±5 %		1.40 ±5 %	
2000	40.0 ±5 %		1.40 ±5 %	
2100	39.8 ±5 %		1.49 ±5 %	
2300	39.5 ±5 %		1.67 ±5 %	
2450	39.2 ±5 %		1.80 ±5 %	
2600	39.0 ±5 %		1.96 ±5 %	
3000	38.5 ±5 %		2.40 ±5 %	
3500	37.9 ±5 %		2.95 ±5 %	

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

The IEEE Std. 1528 and C63/IEC 62209 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured SAR is given with the used input power.

Software	OPENSAR V4
Phantom	SN 20V09 SAM71
Probe	SN 18711 EPG122
Liquid	Head Liquid Values: $\epsilon_{\text{rms}} = 41.1$ $\sigma_{\text{rms}} = 1.39$
Distance between dipole center and liquid	10.0 mm
Area scan resolution	$dx=8\text{mm}/dy=8\text{mm}$
Zoon Scan Resolution	$dx=8\text{mm}/dy=8\text{mm}/dz=5\text{mm}$
Frequency	1800 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)		10 g SAR (W/kg/W)	
	required	measured	required	measured
300	2.85		1.94	
450	4.58		3.06	
750	8.49		5.55	
835	9.56		6.22	
900	10.9		6.98	
1450	29		16	
1500	30.5		16.8	
1640	34.2		18.4	
1750	36.4		19.3	
1800	38.4	38.72 (3.87)	20.1	20.37 (2.04)

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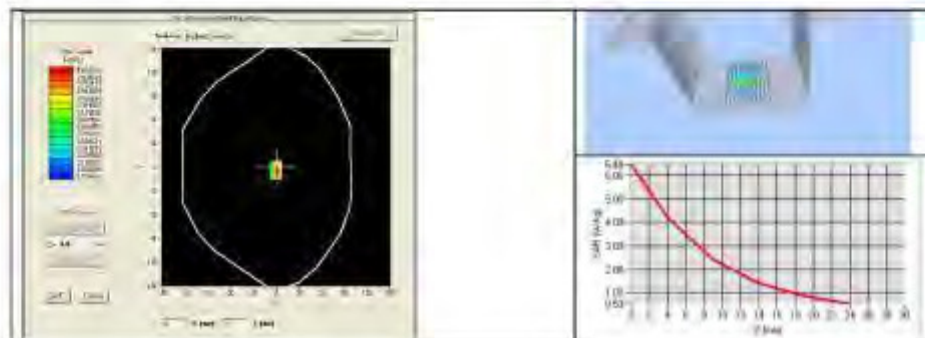
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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-73.10 IS.SATJ.A

1900	39.7		20.5	
1950	40.5		20.8	
2000	41.1		21.1	
2100	43.6		21.9	
2300	48.7		23.3	
2450	52.4		24	
2600	55.3		24.6	
3000	63.8		25.7	
3500	67.1		25	



7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ϵ_r')		Conductivity (σ) S/m	
	required	measured	required	measured
150	61.9 $\pm$ 5 %		0.80 $\pm$ 5 %	
300	58.2 $\pm$ 5 %		0.92 $\pm$ 5 %	
450	56.7 $\pm$ 5 %		0.94 $\pm$ 5 %	
750	55.5 $\pm$ 5 %		0.96 $\pm$ 5 %	
835	55.2 $\pm$ 5 %		0.97 $\pm$ 5 %	
900	55.0 $\pm$ 5 %		1.05 $\pm$ 5 %	
915	55.0 $\pm$ 5 %		1.06 $\pm$ 5 %	
1450	54.0 $\pm$ 5 %		1.30 $\pm$ 5 %	
1610	53.8 $\pm$ 5 %		1.40 $\pm$ 5 %	
1800	53.3 $\pm$ 5 %	PASS	1.52 $\pm$ 5 %	PASS
1900	53.3 $\pm$ 5 %		1.52 $\pm$ 5 %	
2000	53.3 $\pm$ 5 %		1.52 $\pm$ 5 %	
2100	53.2 $\pm$ 5 %		1.62 $\pm$ 5 %	
2450	52.7 $\pm$ 5 %		1.95 $\pm$ 5 %	

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SAR REFERENCE DIPOLE CALIBRATION REPORT

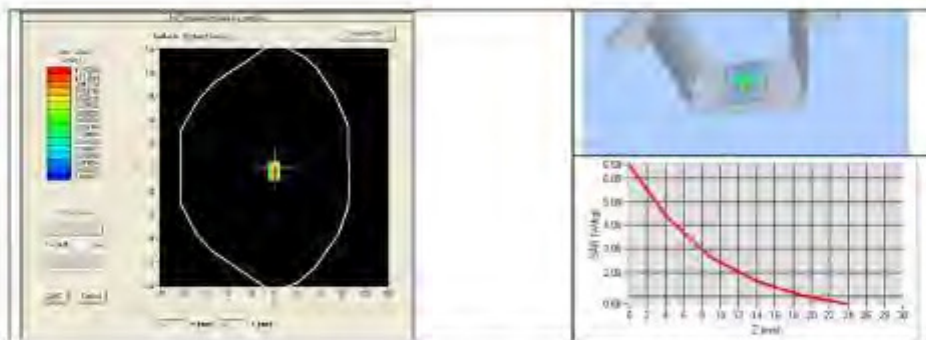
Ref: ACR-73.10.15.SAR11.A

2600	52.5 ±5 %		2.16 ±5 %	
3000	52.0 ±5 %		2.73 ±5 %	
3500	51.3 ±5 %		3.31 ±5 %	
5200	49.0 ±10 %		5.30 ±10 %	
5300	48.9 ±10 %		5.42 ±10 %	
5400	48.7 ±10 %		5.53 ±10 %	
5500	48.6 ±10 %		5.65 ±10 %	
5600	48.5 ±10 %		5.77 ±10 %	
5800	48.2 ±10 %		6.00 ±10 %	

7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V4
Phantom	SN 20109 SAM71
Probe	SN 18111 EPG122
Liquid	Body Liquid Values: eps = 53.0 sigma = 1.52
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoom Scan Resolution	dx=8mm/dy=8m/dz=5mm
Frequency	1800 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)
	measured	measured
1800	40.42 (4.04)	21.53 (2.15)



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SAR REFERENCE DIPOLE CALIBRATION REPORT

Rev: ACE-75.10 (5 S&IT) / A

8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
SAM Phantom	MVG	SN-2009-SAM71	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2013	02/2016
Calipers	Carrera	CALIPER-01	12/2013	12/2016
Reference Probe	MVG	EPG122 SN 18/11	10/2014	10/2015
Multimeter	Keithley 2000	1188656	12/2013	12/2016
Signal Generator	Agilent E4438C	MY49070581	12/2013	12/2016
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	12/2013	12/2016
Power Sensor	HP ECP-E26A	US37181460	12/2013	12/2016
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Temperature and Humidity Sensor	Control Company	11-661-9	8/2012	8/2015

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SAR Reference Dipole Calibration Report

Ref: ACR.75.11.15.SAT11.A

SHENZHEN BALUN TECHNOLOGY CO.,LTD.
BLOCK B, FL 1, BAISHA SCIENCE AND TECHNOLOGY
PARK, SHAHE XI ROAD,
NANSHAN DISTRICT, SHENZHEN, GUANGDONG
PROVINCE, P.R. CHINA 518055
MVG COMOSAR REFERENCE DIPOLE
FREQUENCY: 1900 MHZ
SERIAL NO.: SN 25/13 DIP 1G900-249

Calibrated at MVG US
2105 Barrett Park Dr. - Kennesaw, GA 30144



03/16/2015

Summary:

This document presents the method and results from an accredited SAR reference dipole calibration performed in MVG USA using the COMOSAR test bench. All calibration results are traceable to national metrology institutions.



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-751115 SAR/JA

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	3/16/2015	
Checked by :	Jérôme LUC	Product Manager	3/16/2015	
Approved by :	Kim RUTKOWSKI	Quality Manager	3/16/2015	

	Customer Name
Distribution :	SHENZHEN BALUN TECHNOLOGY Co.,Ltd.

Issue	Date	Modifications
A	3/16/2015	Initial release

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-7511ES-SATU-A

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-751115-SAT1/A

1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEEE 1528, FCC KDBs and CEI/IEC 62209 standards for reference dipoles used for SAR measurement system validations and the measurements that were performed to verify that the product complies with the fore mentioned standards.

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 1900 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID1900
Serial Number	SN 25/13 DIP 1G900-249
Product Condition (new / used)	Used

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

MVG's COMOSAR Validation Dipoles are built in accordance to the IEEE 1528, FCC KDBs and CEI/IEC 62209 standards. The product is designed for use with the COMOSAR test bench only.



Figure 1 –MVG COMOSAR Validation Dipole

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-75.11.15.5.611/A

4 MEASUREMENT METHOD

The IEEE 1528, FCC KDBs and CENELEC 62209 standards provide requirements for reference dipoles used for system validation measurements. The following measurements were performed to verify that the product complies with the fore mentioned standards.

4.1 RETURN LOSS REQUIREMENTS

The dipole used for SAR system validation measurements and checks must have a return loss of -20 dB or better. The return loss measurement shall be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards.

4.2 MECHANICAL REQUIREMENTS

The IEEE Std. 1528 and CENELEC 62209 standards specify the mechanical components and dimensions of the validation dipoles, with the dimensions frequency and phantom shell thickness dependent. The COMOSAR test bench employs a 2 mm phantom shell thickness therefore the dipoles sold for use with the COMOSAR test bench comply with the requirements set forth for a 2 mm phantom shell thickness.

5 MEASUREMENT UNCERTAINTY

All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

5.1 RETURN LOSS

The following uncertainties apply to the return loss measurement:

Frequency band	Expanded Uncertainty on Return Loss
400-6000MHz	0.1 dB

5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

Length (mm)	Expanded Uncertainty on Length
3 - 300	0.05 mm

5.3 VALIDATION MEASUREMENT

The guidelines outlined in the IEEE 1528, FCC KDBs, CENELEC EN50361 and CENELEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

Scan Volume	Expanded Uncertainty
1 g	20.3 %

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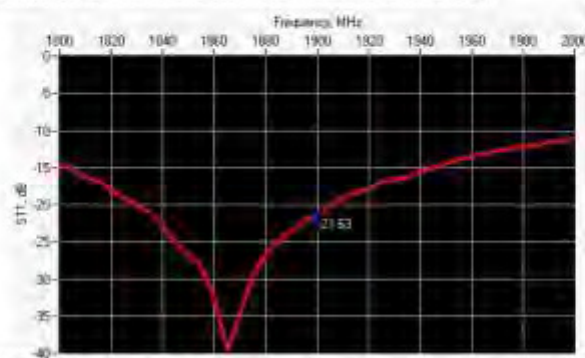
Ref: ACR-751115-SATF-A

10 g

20.1 %

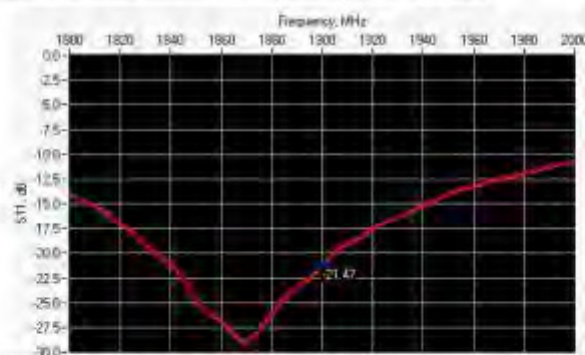
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
1900	-21.63	-20	53.9 Ω + 7.7 j Ω

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
1900	-21.47	-20	48.9 Ω + 8.4 j Ω

6.3 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	420.0 $\pm$ 1 %		250.0 $\pm$ 1 %		6.35 $\pm$ 1 %	

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-751115 SATU.A

450	290.0 ±1 %		166.7 ±1 %		6.35 ±1 %	
750	176.0 ±1 %		100.0 ±1 %		6.35 ±1 %	
835	161.0 ±1 %		89.8 ±1 %		3.6 ±1 %	
900	149.0 ±1 %		83.3 ±1 %		3.6 ±1 %	
1450	89.1 ±1 %		51.7 ±1 %		3.6 ±1 %	
1500	80.5 ±1 %		50.0 ±1 %		3.6 ±1 %	
1640	79.0 ±1 %		45.7 ±1 %		3.6 ±1 %	
1750	75.2 ±1 %		42.9 ±1 %		3.6 ±1 %	
1800	72.0 ±1 %		41.7 ±1 %		3.6 ±1 %	
1900	68.0 ±1 %	PASS	39.5 ±1 %	PASS	3.6 ±1 %	PASS
1950	66.3 ±1 %		38.5 ±1 %		3.6 ±1 %	
2000	64.5 ±1 %		37.5 ±1 %		3.6 ±1 %	
2100	61.0 ±1 %		35.7 ±1 %		3.6 ±1 %	
2300	55.5 ±1 %		32.6 ±1 %		3.6 ±1 %	
2450	51.5 ±1 %		30.4 ±1 %		3.6 ±1 %	
2600	48.5 ±1 %		28.8 ±1 %		3.6 ±1 %	
3000	41.5 ±1 %		25.0 ±1 %		3.6 ±1 %	
3500	37.0 ±1 %		26.4 ±1 %		3.6 ±1 %	
3700	34.7 ±1 %		26.4 ±1 %		3.6 ±1 %	

7 VALIDATION MEASUREMENT

The IEEE Std. 1528, FCC KDBs and CEI/IEC 62209 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

7.1 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε _r)		Conductivity (σ) S/m	
	required	measured	required	measured
300	45.3 ±5 %		0.87 ±5 %	
450	43.5 ±5 %		0.87 ±5 %	
750	41.9 ±5 %		0.88 ±5 %	
835	41.5 ±5 %		0.90 ±5 %	
900	41.5 ±5 %		0.97 ±5 %	
1450	40.5 ±5 %		1.20 ±5 %	
1500	40.4 ±5 %		1.23 ±5 %	
1640	40.2 ±5 %		1.31 ±5 %	
1750	40.1 ±5 %		1.37 ±5 %	

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-7311ES-SATU-A

1800	40.0 ±5 %		1.40 ±5 %	
1900	40.0 ±5 %	PASS	1.40 ±5 %	PASS
1950	40.0 ±5 %		1.40 ±5 %	
2000	40.0 ±5 %		1.40 ±5 %	
2100	39.8 ±5 %		1.49 ±5 %	
2300	39.5 ±5 %		1.67 ±5 %	
2450	39.2 ±5 %		1.80 ±5 %	
2600	39.0 ±5 %		1.96 ±5 %	
3000	38.5 ±5 %		2.40 ±5 %	
3500	37.9 ±5 %		2.85 ±5 %	

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

The IEEE Std. 1528 and CEI/IEC 62209 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured SAR is given with the used input power.

Software	OPENSAR V4
Phantom	SN 20V09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values: $\epsilon_{\text{ps}} = 40.9$ $\sigma_{\text{ps}} = 1.43$
Distance between dipole center and liquid	10.0 mm
Area scan resolution	$dx=8\text{mm}/dy=8\text{mm}$
Zoon Scan Resolution	$dx=8\text{mm}/dy=8\text{mm}/dz=5\text{mm}$
Frequency	1900 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)		10 g SAR (W/kg/W)	
	required	measured	required	measured
300	2.85		1.94	
450	4.58		3.06	
750	8.49		5.55	
835	9.56		6.22	
900	10.9		6.98	
1450	29		16	
1500	30.5		16.8	
1640	34.2		18.8	
1750	36.4		19.3	
1800	38.4		20.1	

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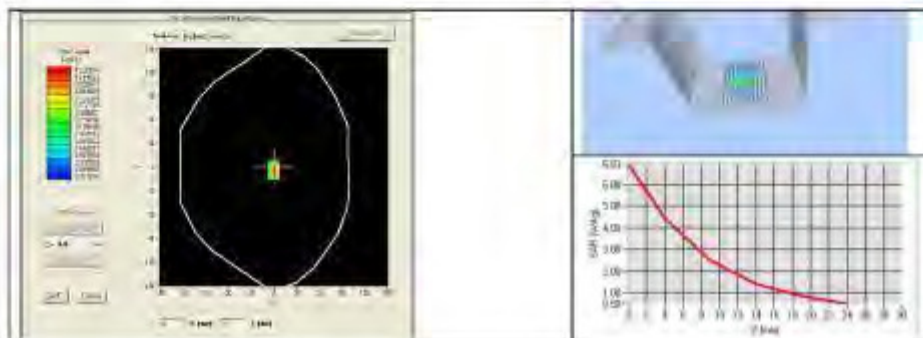
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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.75.1.1.15.SA11/A

1900	39.7	40.75 (4.06)	20.5	20.82 (2.08)
1950	40.5		20.9	
2000	41.1		21.1	
2100	43.6		21.9	
2300	48.7		23.3	
2450	52.4		24	
2600	55.3		24.6	
3000	63.8		25.7	
3500	67.1		25	



7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ϵ_r)		Conductivity (σ) S/m	
	required	measured	required	measured
150	61.9 $\pm$ 5 %		0.80 $\pm$ 5 %	
300	58.2 $\pm$ 5 %		0.92 $\pm$ 5 %	
450	56.7 $\pm$ 5 %		0.94 $\pm$ 5 %	
750	55.5 $\pm$ 5 %		0.96 $\pm$ 5 %	
835	55.2 $\pm$ 5 %		0.97 $\pm$ 5 %	
900	55.0 $\pm$ 5 %		1.05 $\pm$ 5 %	
915	55.0 $\pm$ 5 %		1.06 $\pm$ 5 %	
1450	54.0 $\pm$ 5 %		1.30 $\pm$ 5 %	
1610	53.8 $\pm$ 5 %		1.40 $\pm$ 5 %	
1800	53.3 $\pm$ 5 %		1.52 $\pm$ 5 %	
1900	53.3 $\pm$ 5 %	PASS	1.52 $\pm$ 5 %	PASS
2000	53.3 $\pm$ 5 %		1.52 $\pm$ 5 %	
2100	53.2 $\pm$ 5 %		1.62 $\pm$ 5 %	
2450	52.7 $\pm$ 5 %		1.95 $\pm$ 5 %	

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SAR REFERENCE DIPOLE CALIBRATION REPORT

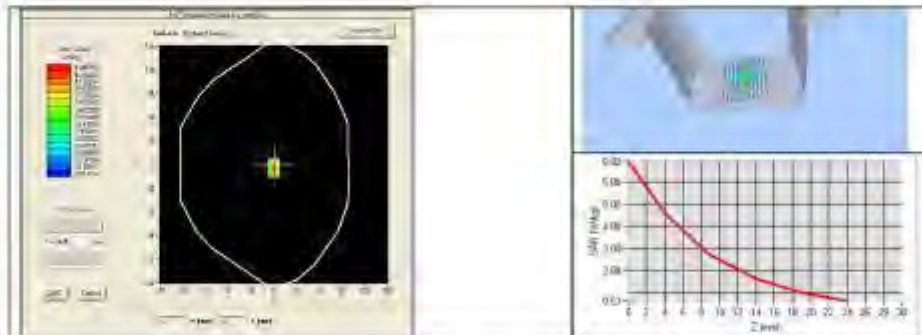
Ref: ACR-751115 SAR11A

2600	52.5 ±5 %		2.16 ±5 %	
3000	52.0 ±5 %		2.73 ±5 %	
3500	51.3 ±5 %		3.31 ±5 %	
5200	49.0 ±10 %		5.30 ±10 %	
5300	48.9 ±10 %		5.42 ±10 %	
5400	48.7 ±10 %		5.53 ±10 %	
5500	48.6 ±10 %		5.65 ±10 %	
5600	48.5 ±10 %		5.77 ±10 %	
5800	48.2 ±10 %		6.00 ±10 %	

7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V4
Phantom	SN 20109 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values: $\epsilon_{ps} = 53.9$ $\sigma_{ps} = 1.55$
Distance between dipole center and liquid	10.0 mm
Area scan resolution	$dx=8mm/dy=8mm$
Zoon Scan Resolution	$dx=8mm/dy=8m/dz=5mm$
Frequency	1900 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)
	measured	measured
1900	42.06 (4.21)	21.87 (2.19)



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SAR REFERENCE DIPOLE CALIBRATION REPORT

Rev: ACR-751115-SAT/A

8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
SAM Phantom	MVG	SN-2009-SAM71	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2013	02/2016
Calipers	Carrera	CALIPER-01	12/2013	12/2016
Reference Probe	MVG	EPG122-SN 18/11	10/2014	10/2015
Multimeter	Keithley 2000	1188656	12/2013	12/2016
Signal Generator	Agilent E4438C	MY49070681	12/2013	12/2016
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	12/2013	12/2016
Power Sensor	HP ECP-E26A	US37181480	12/2013	12/2016
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Temperature and Humidity Sensor	Control Company	11-661-9	8/2012	8/2015

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SAR Reference Dipole Calibration Report

Ref: ACR.75.13.15.SATU.A

SHENZHEN BALUN TECHNOLOGY CO.,LTD.
BLOCK B, FL 1, BAISHA SCIENCE AND TECHNOLOGY
PARK, SHAHE XI ROAD,
NANSHAN DISTRICT, SHENZHEN, GUANGDONG
PROVINCE, P.R. CHINA 518055
MVG COMOSAR REFERENCE DIPOLE
FREQUENCY: 2450 MHZ
SERIAL NO.: SN 25/13 DIP 2G450-251

Calibrated at MVG US
2105 Barrett Park Dr. - Kennesaw, GA 30144



03/16/2015

Summary:

This document presents the method and results from an accredited SAR reference dipole calibration performed in MVG USA using the COMOSAR test bench. All calibration results are traceable to national metrology institutions.



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-7213 ES SAR/1-A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	3/16/2015	
Checked by :	Jérôme LUC	Product Manager	3/16/2015	
Approved by :	Kim RUTKOWSKI	Quality Manager	3/16/2015	

	Customer Name
Distribution :	SHENZHEN BALUN TECHNOLOGY Co.,Ltd.

Issue	Date	Modifications
A	3/16/2015	Initial release

Page: 2/11

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Rev: ACE-73.13.15.SA(1).A

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-75.13.F5.SA111.A

1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEEE 1528, FCC KDBs and CEI/IEC 62209 standards for reference dipoles used for SAR measurement system validations and the measurements that were performed to verify that the product complies with the fore mentioned standards.

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 2450 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID2450
Serial Number	SN 25/13 DIP 2G450-251
Product Condition (new / used)	Used

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

MVG's COMOSAR Validation Dipoles are built in accordance to the IEEE 1528, FCC KDBs and CEI/IEC 62209 standards. The product is designed for use with the COMOSAR test bench only.



Figure 1 – MVG COMOSAR Validation Dipole

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-7213 ES SAR/UK

4 MEASUREMENT METHOD

The IEEE 1528, FCC KDBs and CENELEC 62209 standards provide requirements for reference dipoles used for system validation measurements. The following measurements were performed to verify that the product complies with the fore mentioned standards.

4.1 RETURN LOSS REQUIREMENTS

The dipole used for SAR system validation measurements and checks must have a return loss of >20 dB or better. The return loss measurement shall be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards.

4.2 MECHANICAL REQUIREMENTS

The IEEE Std. 1528 and CENELEC 62209 standards specify the mechanical components and dimensions of the validation dipoles, with the dimensions frequency and phantom shell thickness dependent. The COMOSAR test bench employs a 2 mm phantom shell thickness therefore the dipoles sold for use with the COMOSAR test bench comply with the requirements set forth for a 2 mm phantom shell thickness.

5 MEASUREMENT UNCERTAINTY

All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

5.1 RETURN LOSS

The following uncertainties apply to the return loss measurement:

Frequency band	Expanded Uncertainty on Return Loss
400-6000MHz	0.1 dB

5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

Length (mm)	Expanded Uncertainty on Length
3 - 300	0.05 mm

5.3 VALIDATION MEASUREMENT

The guidelines outlined in the IEEE 1528, FCC KDBs, CENELEC EN50361 and CENELEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

Scan Volume	Expanded Uncertainty
1 g	20.3 %

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SAR REFERENCE DIPOLE CALIBRATION REPORT

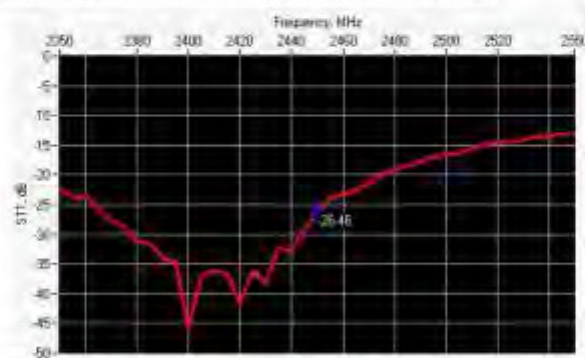
Ref: ACTR.75.13.F5.SA11F.A

10 g

20.1 %₀

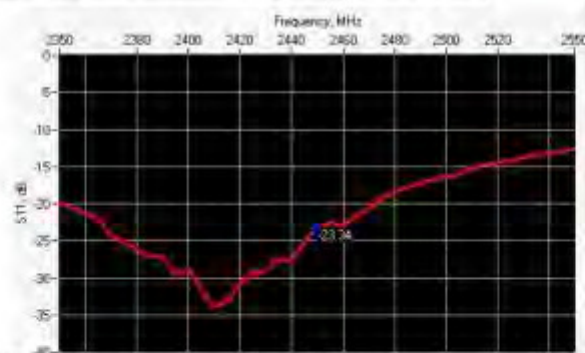
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2450	-26.46	-20	49.3 Ω - 4.7 j Ω

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2450	-23.34	-20	53.4 Ω - 6.2 j Ω

6.3 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	420.0 $\pm$ 1 %		250.0 $\pm$ 1 %		6.35 $\pm$ 1 %	

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-7213 ES SAR/FA

450	290.0 ±1 %		166.7 ±1 %		6.35 ±1 %	
750	176.0 ±1 %		100.0 ±1 %		6.35 ±1 %	
835	161.0 ±1 %		89.8 ±1 %		3.6 ±1 %	
900	149.0 ±1 %		83.3 ±1 %		3.6 ±1 %	
1450	89.1 ±1 %		51.7 ±1 %		3.6 ±1 %	
1500	80.5 ±1 %		50.0 ±1 %		3.6 ±1 %	
1640	79.0 ±1 %		45.7 ±1 %		3.6 ±1 %	
1750	75.2 ±1 %		42.9 ±1 %		3.6 ±1 %	
1800	72.0 ±1 %		41.7 ±1 %		3.6 ±1 %	
1900	68.0 ±1 %		39.5 ±1 %		3.6 ±1 %	
1950	66.3 ±1 %		38.5 ±1 %		3.6 ±1 %	
2000	64.5 ±1 %		37.5 ±1 %		3.6 ±1 %	
2100	61.0 ±1 %		35.7 ±1 %		3.6 ±1 %	
2300	55.5 ±1 %		32.6 ±1 %		3.6 ±1 %	
2450	51.5 ±1 %	PASS	30.4 ±1 %	PASS	3.6 ±1 %	PASS
2600	48.5 ±1 %		28.8 ±1 %		3.6 ±1 %	
3000	41.5 ±1 %		25.0 ±1 %		3.6 ±1 %	
3500	37.0 ±1 %		26.4 ±1 %		3.6 ±1 %	
3700	34.7 ±1 %		26.4 ±1 %		3.6 ±1 %	

7 VALIDATION MEASUREMENT

The IEEE Std. 1528, FCC KDBs and CEI/EC 62209 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

7.1 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε _r)		Conductivity (σ) S/m	
	required	measured	required	measured
300	45.3 ±5 %		0.87 ±5 %	
450	43.5 ±5 %		0.87 ±5 %	
750	41.9 ±5 %		0.88 ±5 %	
835	41.5 ±5 %		0.90 ±5 %	
900	41.5 ±5 %		0.97 ±5 %	
1450	40.5 ±5 %		1.20 ±5 %	
1500	40.4 ±5 %		1.23 ±5 %	
1640	40.2 ±5 %		1.31 ±5 %	
1750	40.1 ±5 %		1.37 ±5 %	

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-72 13 03 SAR/1-A

1800	40.0 ±5 %		1.40 ±5 %	
1900	40.0 ±5 %		1.40 ±5 %	
1950	40.0 ±5 %		1.40 ±5 %	
2000	40.0 ±5 %		1.40 ±5 %	
2100	39.8 ±5 %		1.49 ±5 %	
2300	39.5 ±5 %		1.67 ±5 %	
2450	39.2 ±5 %	PASS	1.80 ±5 %	PASS
2600	39.0 ±5 %		1.96 ±5 %	
3000	38.5 ±5 %		2.40 ±5 %	
3500	37.9 ±5 %		2.80 ±5 %	

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

The IEEE Std. 1528 and CEI/IEC 62209 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured SAR is given with the used input power.

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values: $\epsilon_{\text{eff}} = 38.9$ $\sigma_{\text{eff}} = 1.79$
Distance between dipole center and liquid	10.0 mm
Area scan resolution	$dx=8\text{mm}$ $dy=8\text{mm}$
Zoon Scan Resolution	$dz=5\text{mm}$ $dx=5\text{mm}$ $dy=5\text{mm}$
Frequency	2450 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)		10 g SAR (W/kg/W)	
	required	measured	required	measured
300	2.85		1.94	
450	4.58		3.06	
750	8.49		5.55	
835	9.56		6.22	
900	10.9		6.98	
1450	29		16	
1500	30.5		16.8	
1640	34.2		18.8	
1750	36.4		19.3	
1800	38.4		20.1	

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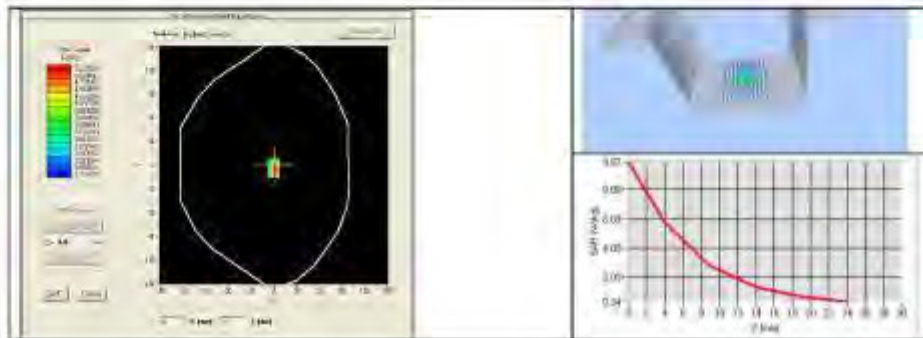
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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-75.13.F5.SA11.A

1900	39.7		20.5	
1950	40.5		20.9	
2000	41.1		21.1	
2100	43.6		21.9	
2300	48.7		23.3	
2450	52.4	54.29 (5.43)	24	24.20 (2.42)
2600	55.3		24.6	
3000	63.8		25.7	
3500	67.1		25	



7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ϵ_r)		Conductivity (σ) S/m	
	required	measured	required	measured
150	61.9 $\pm$ 5 %		0.80 $\pm$ 5 %	
300	58.2 $\pm$ 5 %		0.92 $\pm$ 5 %	
450	56.7 $\pm$ 5 %		0.94 $\pm$ 5 %	
750	55.5 $\pm$ 5 %		0.96 $\pm$ 5 %	
835	55.2 $\pm$ 5 %		0.97 $\pm$ 5 %	
900	55.0 $\pm$ 5 %		1.05 $\pm$ 5 %	
915	55.0 $\pm$ 5 %		1.06 $\pm$ 5 %	
1450	54.0 $\pm$ 5 %		1.30 $\pm$ 5 %	
1610	53.8 $\pm$ 5 %		1.40 $\pm$ 5 %	
1800	53.3 $\pm$ 5 %		1.52 $\pm$ 5 %	
1900	53.3 $\pm$ 5 %		1.52 $\pm$ 5 %	
2000	53.3 $\pm$ 5 %		1.52 $\pm$ 5 %	
2100	53.2 $\pm$ 5 %		1.62 $\pm$ 5 %	
2450	52.7 $\pm$ 5 %	PASS	1.95 $\pm$ 5 %	PASS

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SAR REFERENCE DIPOLE CALIBRATION REPORT

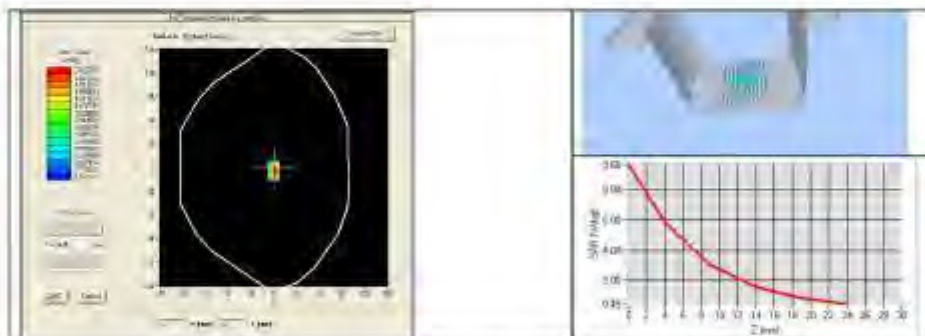
Ref: ACR-75.13.15.SAR11-A

2600	52.5 ±5 %		2.16 ±5 %	
3000	52.0 ±5 %		2.73 ±5 %	
3500	51.3 ±5 %		3.31 ±5 %	
5200	49.0 ±10 %		5.30 ±10 %	
5300	48.9 ±10 %		5.42 ±10 %	
5400	48.7 ±10 %		5.53 ±10 %	
5500	48.6 ±10 %		5.65 ±10 %	
5600	48.5 ±10 %		5.77 ±10 %	
5800	48.2 ±10 %		6.00 ±10 %	

7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V4
Phantom	SN 20109 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values: $\epsilon_{ps} = 52.7$ $\sigma_{ps} = 1.94$
Distance between dipole center and liquid	10.0 mm
Area scan resolution	$dx=8mm/dy=8mm$
Zoom Scan Resolution	$dx=5mm/dy=5m/dz=5mm$
Frequency	2450 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)
	measured	measured
2450	54.70 [5.47]	24.86 [2.48]



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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-75.13.15.SATU.A

8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
SAM Phantom	MVG	SN-20/09-SAM71	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2013	02/2016
Calipers	Garrera	CALIPER-01	12/2013	12/2016
Reference Probe	MVG	EPG122 SN 18/11	10/2014	10/2015
Multimeter	Keithley 2000	1188666	12/2013	12/2016
Signal Generator	Agilent E4438C	MY49070581	12/2013	12/2016
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	12/2013	12/2016
Power Sensor	HP ECP-E26A	US37181460	12/2013	12/2016
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Temperature and Humidity Sensor	Control Company	11-861-9	8/2012	8/2015

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SAR Reference Dipole Calibration Report

Ref: ACR.75.14.15.SATU.A

SHENZHEN BALUN TECHNOLOGY CO.,LTD.
BLOCK B, FL 1, BAISHA SCIENCE AND TECHNOLOGY
PARK, SHAHE XI ROAD,
NANSHAN DISTRICT, SHENZHEN, GUANGDONG
PROVINCE, P.R. CHINA 518055
MVG COMOSAR REFERENCE DIPOLE
FREQUENCY: 2600 MHZ
SERIAL NO.: SN 25/13 DIP 2G600-254

Calibrated at MVG US
2105 Barrett Park Dr. - Kennesaw, GA 30144



03/16/2015

Summary:

This document presents the method and results from an accredited SAR reference dipole calibration performed in MVG USA using the COMOSAR test bench. All calibration results are traceable to national metrology institutions.



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACE-75.14.15.5.011/A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	3/16/2015	<i>JS</i>
Checked by :	Jérôme LUC	Product Manager	3/16/2015	<i>JS</i>
Approved by :	Kim RUTKOWSKI	Quality Manager	3/16/2015	<i>Kim Rutkowski</i>

	Customer Name
Distribution :	SHENZHEN BALUN TECHNOLOGY Co.,Ltd.

Issue	Date	Modifications
A	3/16/2015	Initial release

Page: 2/11

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Rev: ACE-75.14.15.5A(1).A

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5.2	Dimension Measurement	5
5.3	Validation Measurement	5
6	Calibration Measurement Results	6
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6.2	Return Loss and Impedance In Body Liquid	6
6.3	Mechanical Dimensions	6
7	Validation measurement	7
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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-73.14.13.5A(1).A

1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEEE 1528, FCC KDBs and CEI/IEC 62209 standards for reference dipoles used for SAR measurement system validations and the measurements that were performed to verify that the product complies with the fore mentioned standards.

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 2600 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID2600
Serial Number	SN 25/13 DIP 2G600-254
Product Condition (new / used)	Used

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

MVG's COMOSAR Validation Dipoles are built in accordance to the IEEE 1528, FCC KDBs and CEI/IEC 62209 standards. The product is designed for use with the COMOSAR test bench only.



Figure 1 – MVG COMOSAR Validation Dipole

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Rev: ACE-75.14 (5.5.0) / A

4 MEASUREMENT METHOD

The IEEE 1528, FCC KDBs and CEM/IEC 62209 standards provide requirements for reference dipoles used for system validation measurements. The following measurements were performed to verify that the product complies with the fore mentioned standards.

4.1 RETURN LOSS REQUIREMENTS

The dipole used for SAR system validation measurements and checks must have a return loss of -20 dB or better. The return loss measurement shall be performed against a liquid filled flat phantom with the phantom constructed as outlined in the fore mentioned standards.

4.2 MECHANICAL REQUIREMENTS

The IEEE Std. 1528 and CEM/IEC 62209 standards specify the mechanical components and dimensions of the validation dipoles, with the dimensions frequency and phantom shell thickness dependent. The COMOSAR test bench employs a 2 mm phantom shell thickness therefore the dipoles sold for use with the COMOSAR test bench comply with the requirements set forth for a 2 mm phantom shell thickness.

5 MEASUREMENT UNCERTAINTY

All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

5.1 RETURN LOSS

The following uncertainties apply to the return loss measurement:

Frequency band	Expanded Uncertainty on Return Loss
400-6000MHz	0.1 dB

5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

Length (mm)	Expanded Uncertainty on Length
3 - 300	0.05 mm

5.3 VALIDATION MEASUREMENT

The guidelines outlined in the IEEE 1528, FCC KDBs, CENELEC EN50361 and CEM/IEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

Scan Volume	Expanded Uncertainty
1 g	20.3 %

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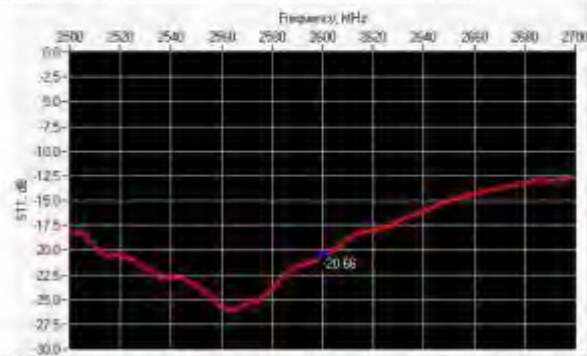
SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.73.14.13.SATTJ.A

10 g	20.1 %
------	--------

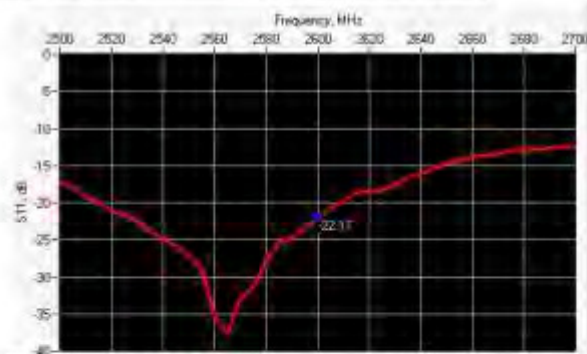
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2600	-20.66	-20	$51.0 \Omega + 9.4 j\Omega$

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2600	-22.17	-20	$47.9 \Omega + 7.5 j\Omega$

6.3 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	$420.0 \pm 1 \%$		$250.0 \pm 1 \%$		$6.35 \pm 1 \%$	

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACB-75.14.13.5.6111.A

450	290.0 ±1 %		166.7 ±1 %		6.35 ±1 %	
750	176.0 ±1 %		100.0 ±1 %		6.35 ±1 %	
835	161.0 ±1 %		89.8 ±1 %		3.6 ±1 %	
900	149.0 ±1 %		83.3 ±1 %		3.6 ±1 %	
1450	89.1 ±1 %		51.7 ±1 %		3.6 ±1 %	
1500	80.5 ±1 %		50.0 ±1 %		3.6 ±1 %	
1640	79.0 ±1 %		45.7 ±1 %		3.6 ±1 %	
1750	75.2 ±1 %		42.8 ±1 %		3.6 ±1 %	
1800	72.0 ±1 %		41.7 ±1 %		3.6 ±1 %	
1900	68.0 ±1 %		39.5 ±1 %		3.6 ±1 %	
1950	66.3 ±1 %		38.5 ±1 %		3.6 ±1 %	
2000	64.5 ±1 %		37.5 ±1 %		3.6 ±1 %	
2100	61.0 ±1 %		35.7 ±1 %		3.6 ±1 %	
2300	55.5 ±1 %		32.6 ±1 %		3.6 ±1 %	
2450	51.5 ±1 %		30.4 ±1 %		3.6 ±1 %	
2600	48.5 ±1 %	PASS	28.8 ±1 %	PASS	3.6 ±1 %	PASS
3000	41.5 ±1 %		25.0 ±1 %		3.6 ±1 %	
3500	37.0 ±1 %		26.4 ±1 %		3.6 ±1 %	
3700	34.7 ±1 %		26.4 ±1 %		3.6 ±1 %	

7 VALIDATION MEASUREMENT

The IEEE Std. 1528, FCC KDBs and CEI/IEC 62209 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

7.1 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε _r)		Conductivity (σ) S/m	
	required	measured	required	measured
300	45.3 ±5 %		0.87 ±5 %	
450	43.5 ±5 %		0.87 ±5 %	
750	41.9 ±5 %		0.88 ±5 %	
835	41.5 ±5 %		0.90 ±5 %	
900	41.5 ±5 %		0.97 ±5 %	
1450	40.5 ±5 %		1.20 ±5 %	
1500	40.4 ±5 %		1.23 ±5 %	
1640	40.2 ±5 %		1.31 ±5 %	
1750	40.1 ±5 %		1.37 ±5 %	

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Rev: ACE-75.14.13 SAR11.A

1800	40.0 ±5 %		1.40 ±5 %	
1900	40.0 ±5 %		1.40 ±5 %	
1950	40.0 ±5 %		1.40 ±5 %	
2000	40.0 ±5 %		1.40 ±5 %	
2100	39.8 ±5 %		1.49 ±5 %	
2300	39.5 ±5 %		1.67 ±5 %	
2450	39.2 ±5 %		1.80 ±5 %	
2600	39.0 ±5 %	PASS	1.96 ±5 %	PASS
3000	38.5 ±5 %		2.40 ±5 %	
3500	37.9 ±5 %		2.95 ±5 %	

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

The IEEE Std. 1528 and C61/IEC 62209 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured SAR is given with the used input power.

Software	OPENSAR V4
Phantom	SN 20V09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values: $\epsilon_{\text{rms}} = 38.2 \pm 0.3$
Distance between dipole center and liquid	10.0 mm
Area scan resolution	$dx=8\text{mm}/dy=8\text{mm}$
Zoon Scan Resolution	$dx=5\text{mm}/dy=5\text{mm}/dz=5\text{mm}$
Frequency	2600 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)		10 g SAR (W/kg/W)	
	required	measured	required	measured
300	2.85		1.94	
450	4.58		3.06	
750	8.49		5.55	
835	9.56		6.22	
900	10.9		6.98	
1450	29		16	
1500	30.5		16.8	
1640	34.2		18.4	
1750	36.4		19.3	
1800	38.4		20.1	

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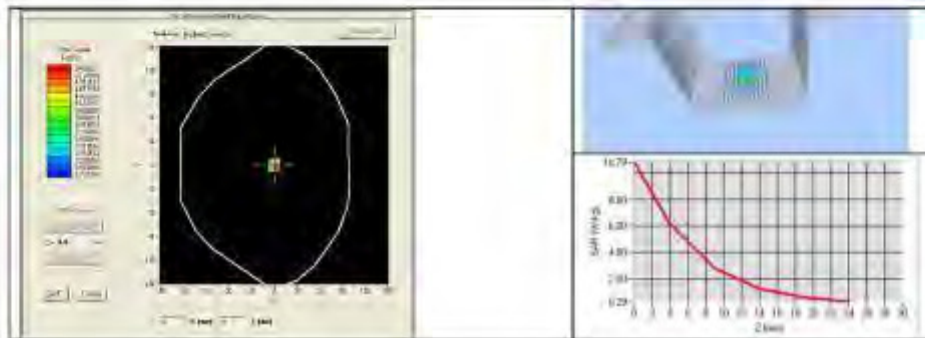
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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.73.14.15.SAR11.A

1900	39.7		20.5	
1950	40.5		20.8	
2000	41.1		21.1	
2100	43.6		21.9	
2300	48.7		23.3	
2450	52.4		24	
2600	55.3	57.37 (5.74)	24.6	24.68 (2.47)
3000	63.8		25.7	
3500	67.1		25	



7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ϵ_r)		Conductivity (σ) S/m	
	required	measured	required	measured
150	61.9 $\pm$ 5 %		0.80 $\pm$ 5 %	
300	58.2 $\pm$ 5 %		0.92 $\pm$ 5 %	
450	56.7 $\pm$ 5 %		0.94 $\pm$ 5 %	
750	55.5 $\pm$ 5 %		0.96 $\pm$ 5 %	
835	55.2 $\pm$ 5 %		0.97 $\pm$ 5 %	
900	55.0 $\pm$ 5 %		1.05 $\pm$ 5 %	
915	55.0 $\pm$ 5 %		1.06 $\pm$ 5 %	
1450	54.0 $\pm$ 5 %		1.30 $\pm$ 5 %	
1610	53.8 $\pm$ 5 %		1.40 $\pm$ 5 %	
1800	53.3 $\pm$ 5 %		1.52 $\pm$ 5 %	
1900	53.3 $\pm$ 5 %		1.52 $\pm$ 5 %	
2000	53.3 $\pm$ 5 %		1.52 $\pm$ 5 %	
2100	53.2 $\pm$ 5 %		1.62 $\pm$ 5 %	
2450	52.7 $\pm$ 5 %		1.95 $\pm$ 5 %	

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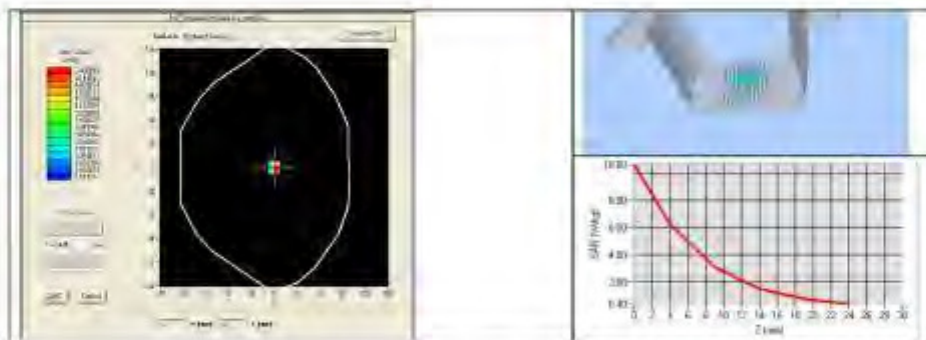
Ref: ACR-73.14.13.5ACIT1.A

2600	52.5 ±5 %	PASS	2.16 ±5 %	PASS
3000	52.0 ±5 %		2.73 ±5 %	
3500	51.3 ±5 %		3.31 ±5 %	
5200	49.0 ±10 %		5.30 ±10 %	
5300	48.9 ±10 %		5.42 ±10 %	
5400	48.7 ±10 %		5.53 ±10 %	
5500	48.6 ±10 %		5.65 ±10 %	
5600	48.5 ±10 %		5.77 ±10 %	
5800	48.2 ±10 %		6.00 ±10 %	

7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V4
Phantom	SN 20109 SAM71
Probe	SN 18111 EPG122
Liquid	Body Liquid Values: $\epsilon_{ps} = 51.6$ $\sigma_{ps} = 2.21$
Distance between dipole center and liquid	10.0 mm
Area scan resolution	$dx=8mm/dy=8mm$
Zoom Scan Resolution	$dx=5mm/dy=5mm/dz=5mm$
Frequency	2600 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)
	measured	measured
2600	57.62 (5.76)	25.39 (2.54)



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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR-7514-15 SAR/TA

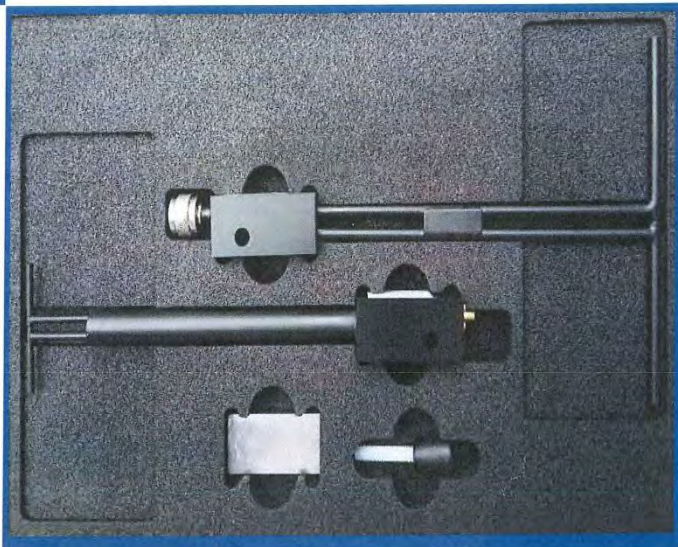
8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
SAM Phantom	MVG	SN-2009-SAM71	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2013	02/2016
Calipers	Carrera	CALIPER-01	12/2013	12/2016
Reference Probe	MVG	EPG122 SN 16/11	10/2014	10/2015
Multimeter	Keithley 2000	1188656	12/2013	12/2016
Signal Generator	Agilent E4438C	MY49070681	12/2013	12/2016
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	12/2013	12/2016
Power Sensor	HP ECP-E26A	US37181480	12/2013	12/2016
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Temperature and Humidity Sensor	Control Company	11-661-9	8/2012	8/2015

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F.8 SATIMO Dipole

SAR*Dipole & Waveguide***Performance
Measurement
Report**ISSUED BY
Shenzhen BALUN Technology Co., Ltd.FOR
Validation Dipoles & Waveguide

Tested by:

Tu Lang
(Engineer)

Approved by:

Liao Jianming
(Technical Director)

Report No.: LW-SZ15C0264-701

EUT Type: SAR Validation Dipole and Waveguide

Model Name: DIP 0G450-252, DIP 0G750-253

DIP 0G835-246, DIP 0G900-247

DIP 1G800-248, DIP 1G900-249

DIP 2G000-250, DIP 2G450-251

DIP 2G600-25, SWG5500

Brand Name: SATIMO

Test Conclusion: Pass

Test Date: Mar. 1, 2016 ~ Mar. 3, 2016

Date of Issue: Mar. 31, 2016

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www.baluntek.com



1 GENERAL INFORMATION

1.1 Introduction

This document contains a summary of the requirements set forth by the IEEE 1528, FCC KDB 865664 D01 for reference dipoles used for SAR measurement system validations. Instead of the typical annual calibration recommended by measurement standards, the reference dipoles were demonstrated that the SAR target, impedance and return loss have remain stable, so the longer calibration interval is acceptable.

1.2 General Description for Equipment under Test (EUT)

Model	Frequency	Serial Number	Product Condition (New/ Used)	Last Cal. Date
Dipole				
DIP 0G450	450 MHz	SN 25/13 DIP 0G450-252	Used	2015/03/16
DIP 0G750	750 MHz	SN 25/13 DIP 0G750-253	Used	2015/03/16
DIP 0G835	835 MHz	SN 25/13 DIP 0G835-246	Used	2015/03/16
DIP 0G900	900 MHz	SN 25/13 DIP 0G900-247	Used	2015/03/16
DIP 1G800	1800 MHz	SN 25/13 DIP 1G900-248	Used	2015/03/16
DIP 1G900	1900 MHz	SN 25/13 DIP 1G900-249	Used	2015/03/16
DIP 2G000	2000 MHz	SN 25/13 DIP 2G000-250	Used	2015/03/16
DIP 2G450	2450 MHz	SN 25/13 DIP 2G450-251	Used	2015/03/16
DIP 2G600	2600 MHz	SN 25/13 DIP 2G600-254	Used	2015/03/16
Waveguide				
SWG5500	5GHz-6GHz	SN 30/13 WGA24	Used	2015/03/16



1.3EUT Photos





DIP 0G835-246

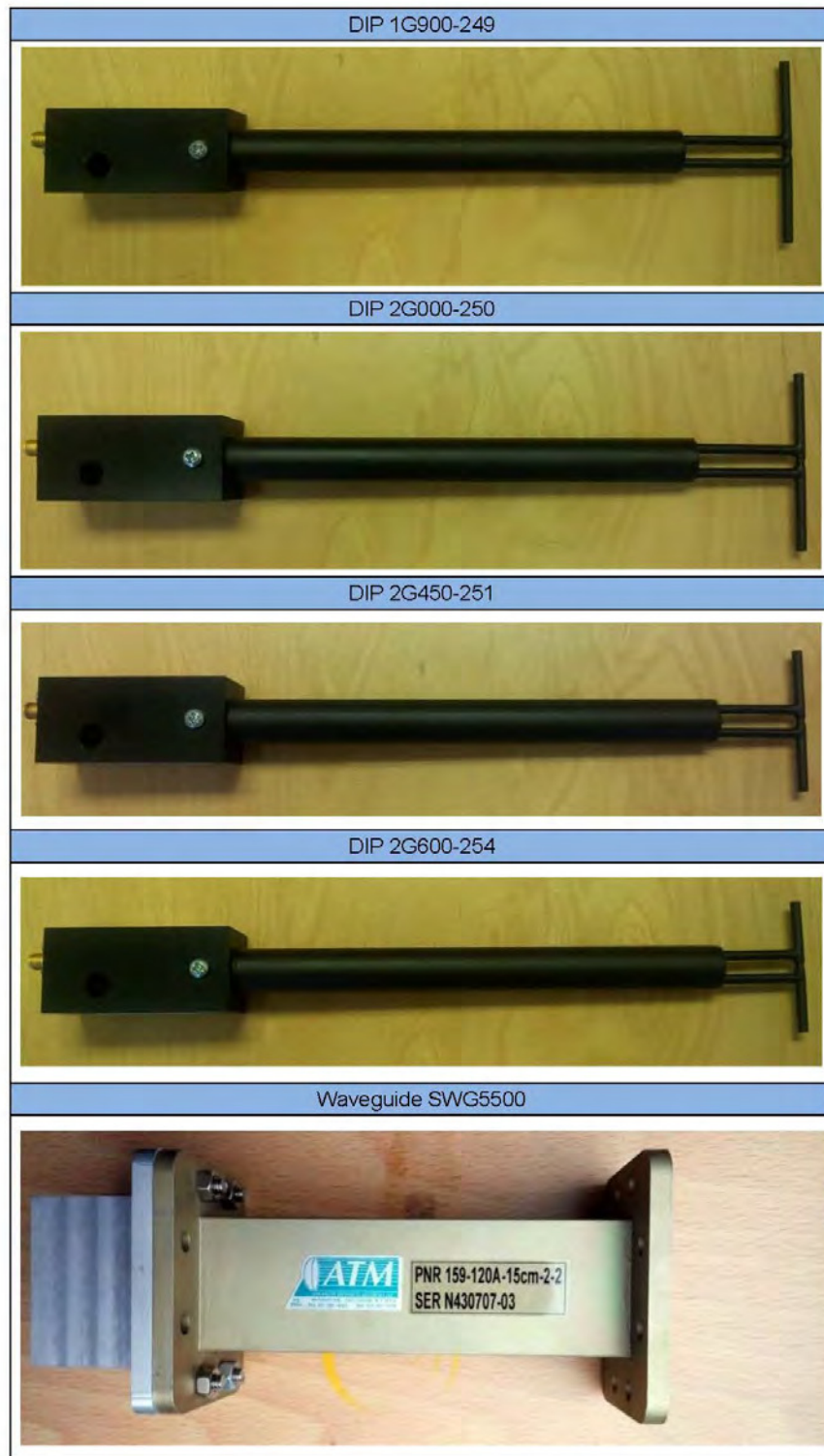


DIP 0G900-247



DIP 1G800-248







2 SIMULATING LIQUID VERIFICATION

Liquid Type	Fre (MHz)	Meas Conductivity (σ) (S/m)	Meas Permittivity (ϵ)	Target Conductivity (σ) (S/m)	Target Permittivity (ϵ)	Conductivity Tolerance (%)	Permittivity Tolerance (%)
Head	450	0.89	42.87	0.87	43.50	2.30	-1.45
Body		0.96	55.70	0.94	56.70	2.13	-1.76
Head	750	0.88	41.92	0.89	41.94	-1.12	-0.05
Body		0.95	57.19	0.96	55.53	-1.04	2.99
Head	835	0.90	43.33	0.90	41.50	0.00	4.41
Body		0.99	54.65	0.97	55.20	2.06	-1.00
Head	900	0.99	41.14	0.97	41.50	2.06	-0.87
Body		1.06	54.93	1.05	55.00	0.95	-0.13
Head	1800	1.41	39.56	1.40	40.00	0.71	-1.10
Body		1.51	54.69	1.52	53.30	-0.66	2.61
Head	1900	1.42	39.40	1.40	40.00	1.43	-1.50
Body		1.53	53.16	1.52	53.30	0.66	-0.26
Head	2000	1.43	38.96	1.40	40.00	2.14	-2.60
Body		1.55	51.53	1.52	53.30	1.97	-3.32
Head	2450	1.82	38.92	1.80	39.20	1.11	-0.71
Body		1.96	52.96	1.95	52.70	0.51	0.49
Head	2600	1.98	38.10	1.96	39.01	1.02	-2.33
Body		2.15	53.51	2.16	52.51	-0.46	1.90
Head	5200	4.64	36.87	4.66	35.99	-0.43	2.45
Body		5.26	50.13	5.30	49.01	-0.75	2.29
Head	5400	4.83	36.43	4.86	35.76	-0.62	1.87
Body		5.51	50.02	5.53	48.74	-0.36	2.63
Head	5600	5.14	34.46	5.07	35.53	1.38	-3.01
Body		5.93	48.04	5.77	48.47	2.77	-0.89
Head	5800	5.31	34.33	5.27	35.30	0.76	-2.75
Body		6.07	47.14	6.00	48.20	1.17	-2.20



3 DIPOLE IMPEDANCE AND RETURN LOSS

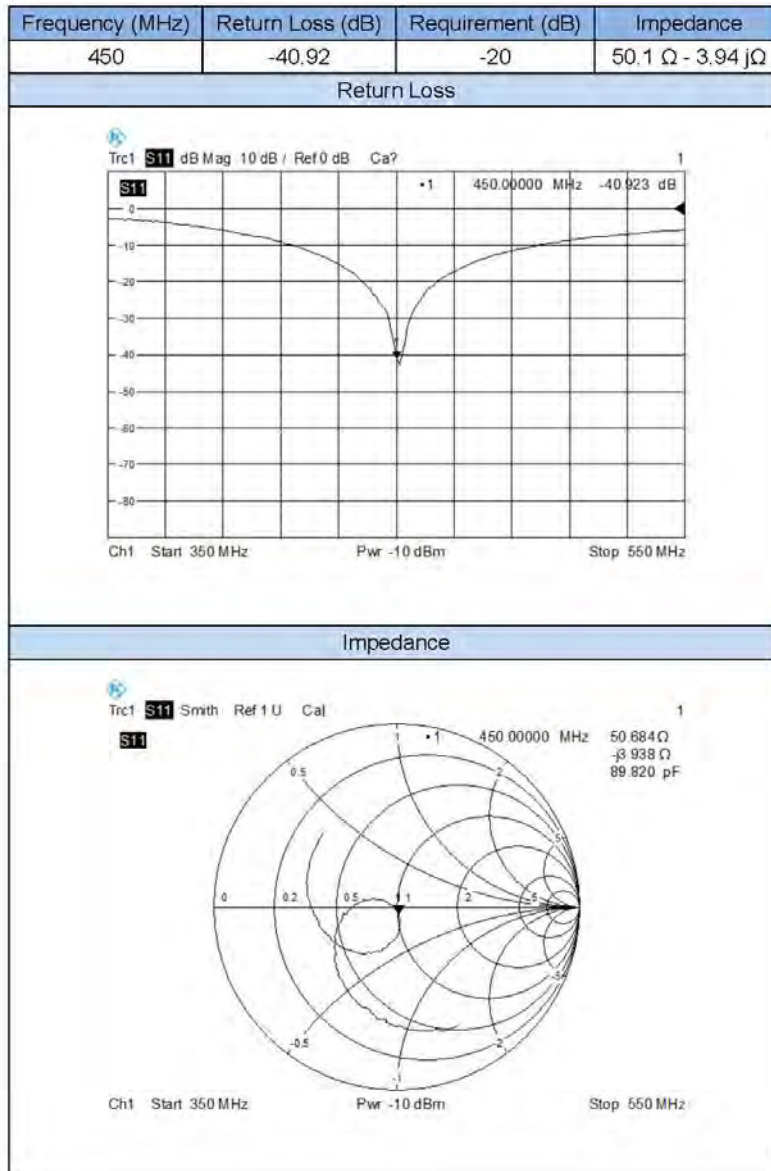
The dipoles are designed to have low return loss when presented against a flat phantom at the specified distance. A Vector Network Analyser was used to perform a return loss measurement on the specific dipole when in the measurement location against the phantom and the distance was specified by the manufacturer with a special, low loss and low relative permittivity spacer.

The impedance was measured at the SMA-connector with the network analyser.



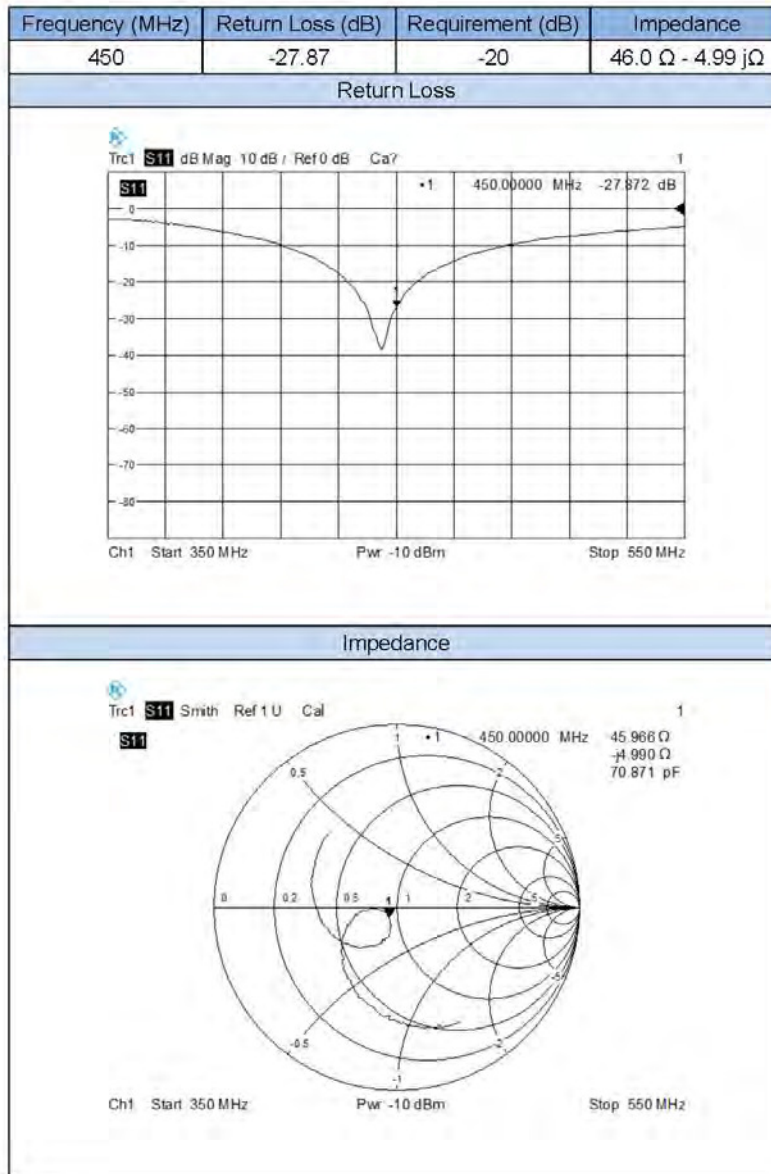
3.1 DIP 0G450

RETURN LOSS AND IMPEDANCE IN HEAD LIQUID





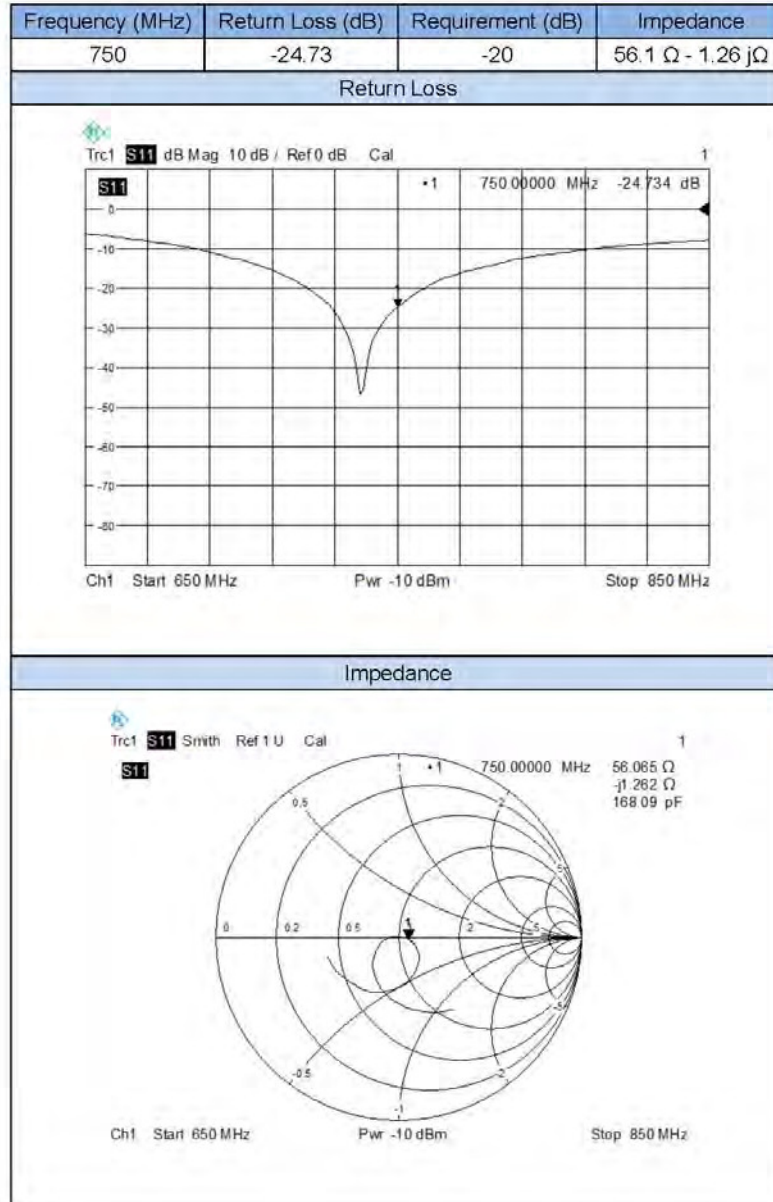
RETURN LOSS AND IMPEDANCE IN BODY LIQUID





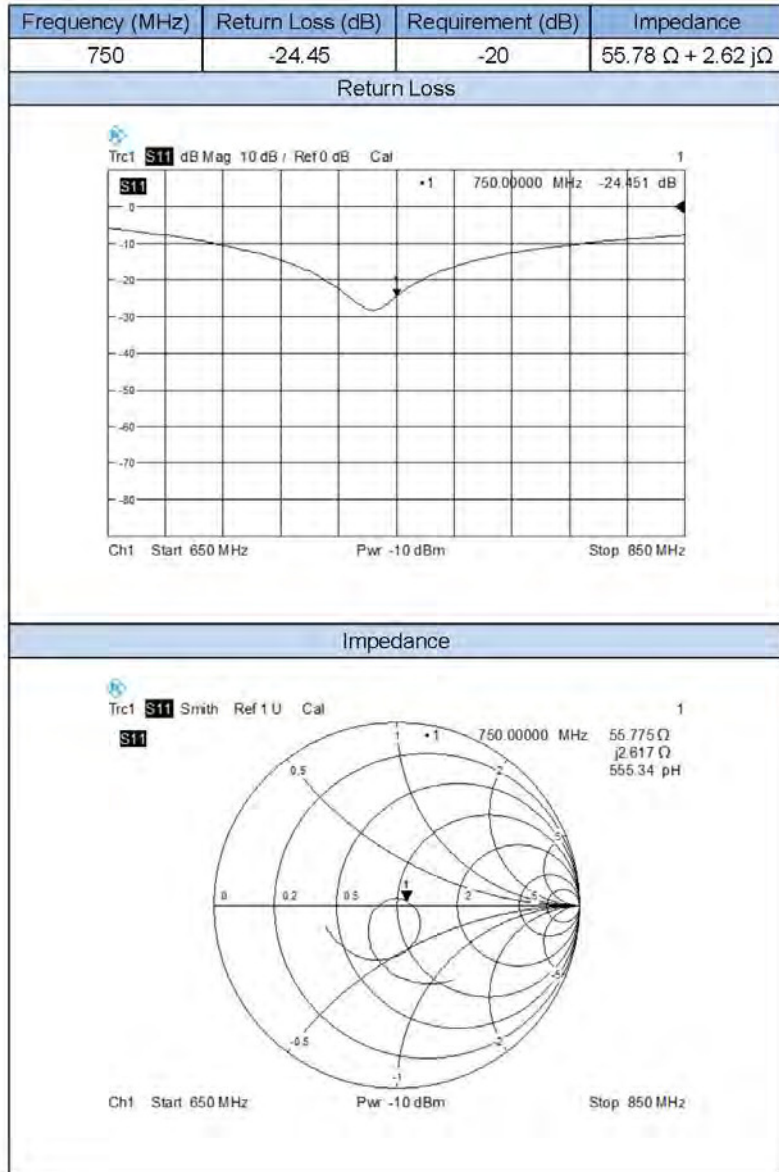
3.2 DIP 0G750

RETURN LOSS AND IMPEDANCE IN HEAD LIQUID





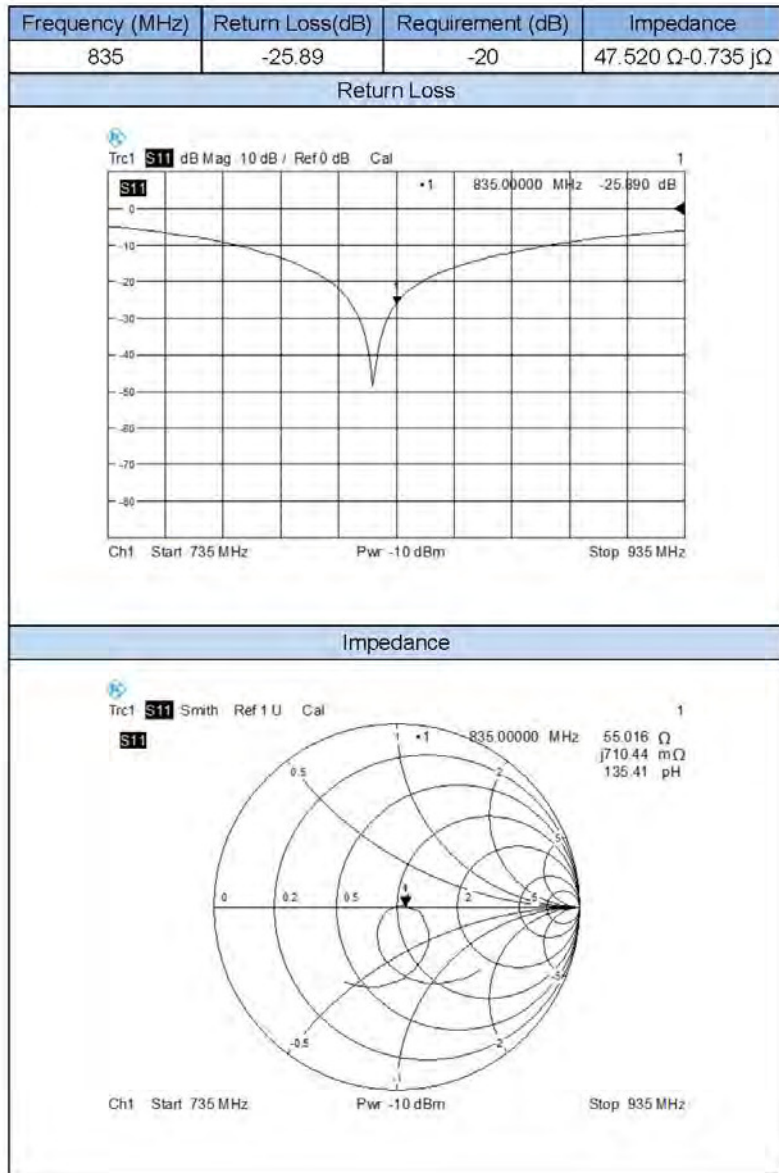
RETURN LOSS AND IMPEDANCE IN BODY LIQUID





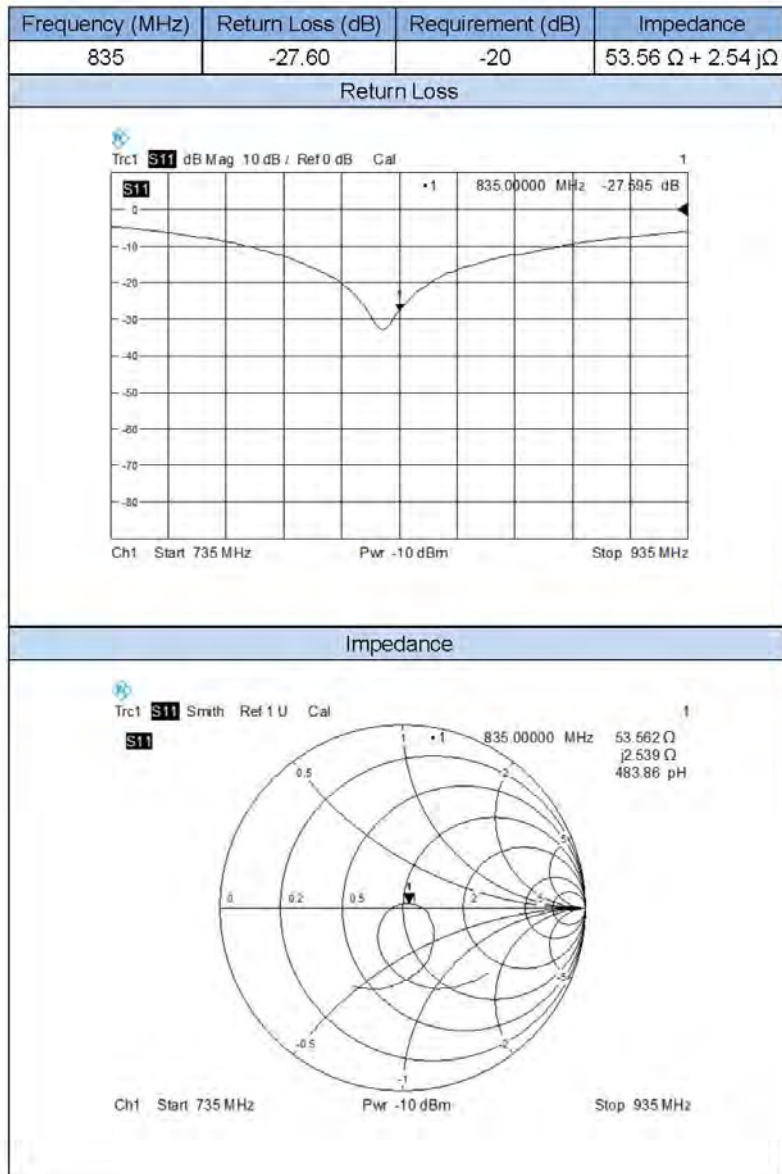
3.3 DIP 0G835

RETURN LOSS AND IMPEDANCE IN HEAD LIQUID





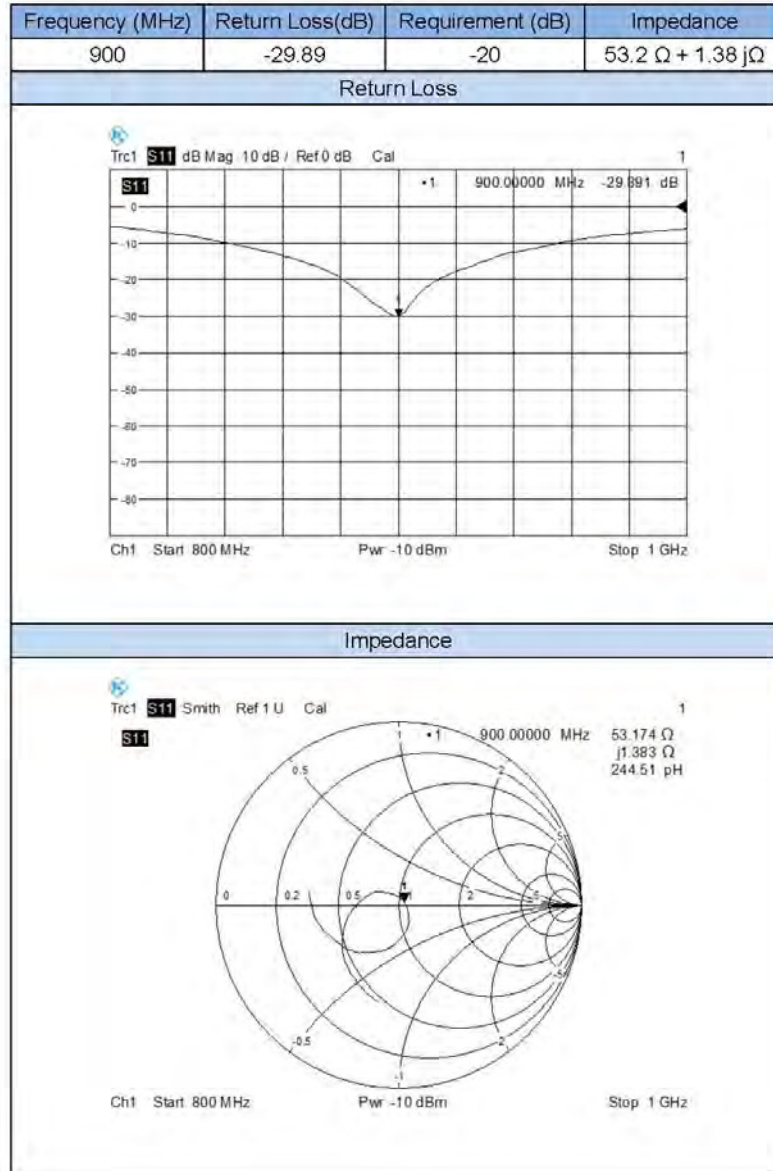
RETURN LOSS AND IMPEDANCE IN BODY LIQUID





3.4 DIP 0G900

RETURN LOSS AND IMPEDANCE IN HEAD LIQUID

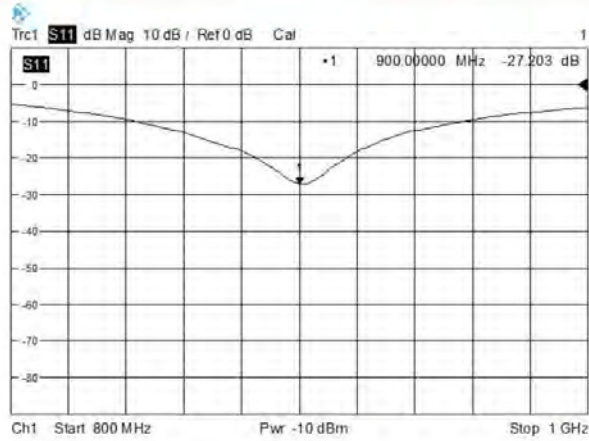




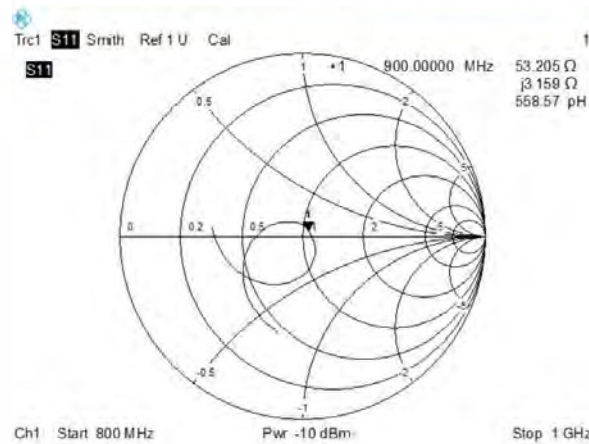
RETURN LOSS AND IMPEDANCE IN BODY LIQUID

Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
900	-27.20	-20	$53.2 \Omega + 3.16 j\Omega$

Return Loss



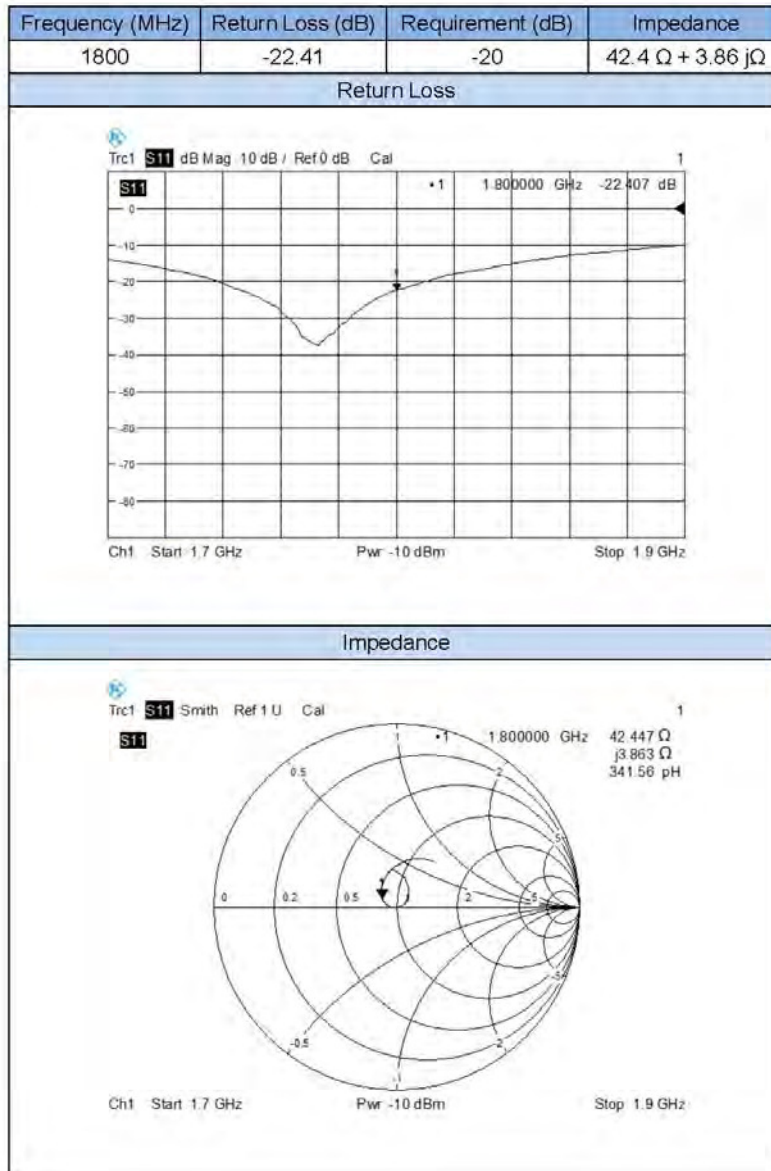
Impedance





3.5 DIP 1G800

RETURN LOSS AND IMPEDANCE IN HEAD LIQUID

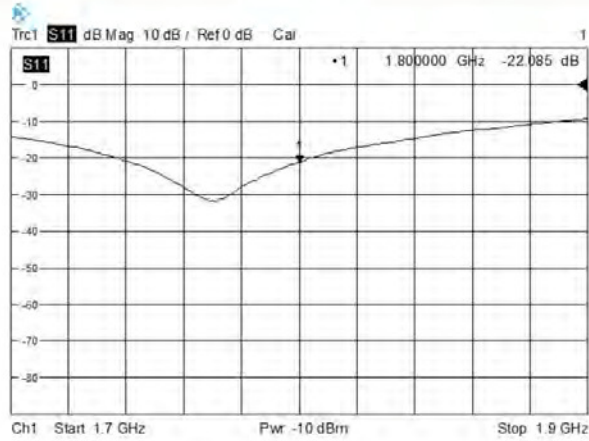




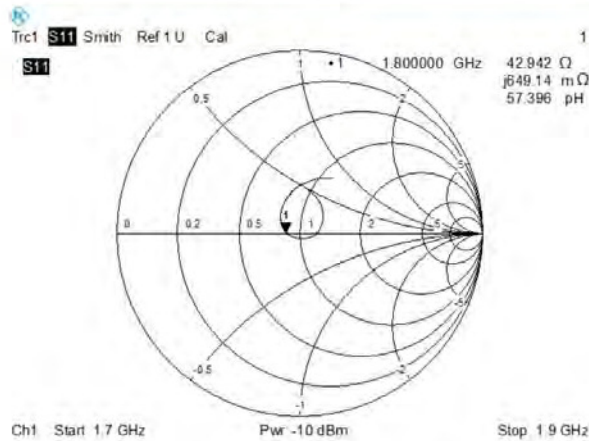
RETURN LOSS AND IMPEDANCE IN BODY LIQUID

Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
1800	-22.09	-20	$42.9 \Omega + 0.65 j\Omega$

Return Loss



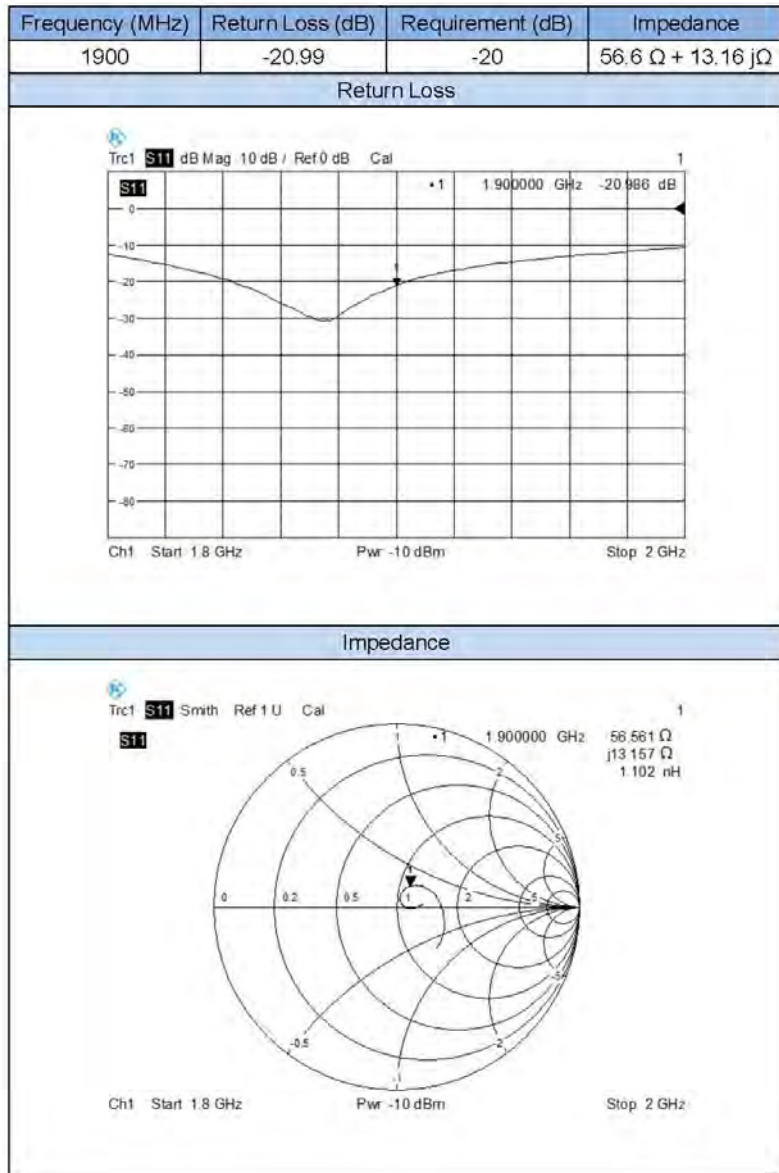
Impedance





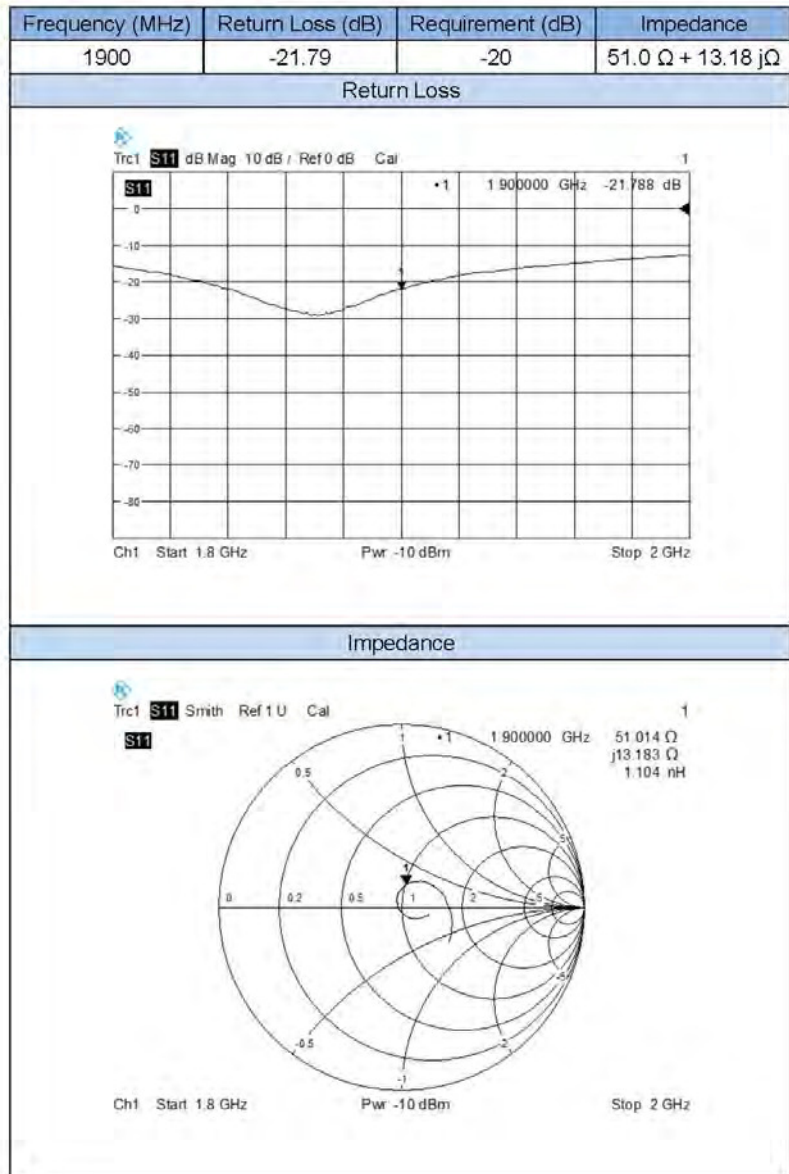
3.6 DIP 1G900

RETURN LOSS AND IMPEDANCE IN HEAD LIQUID





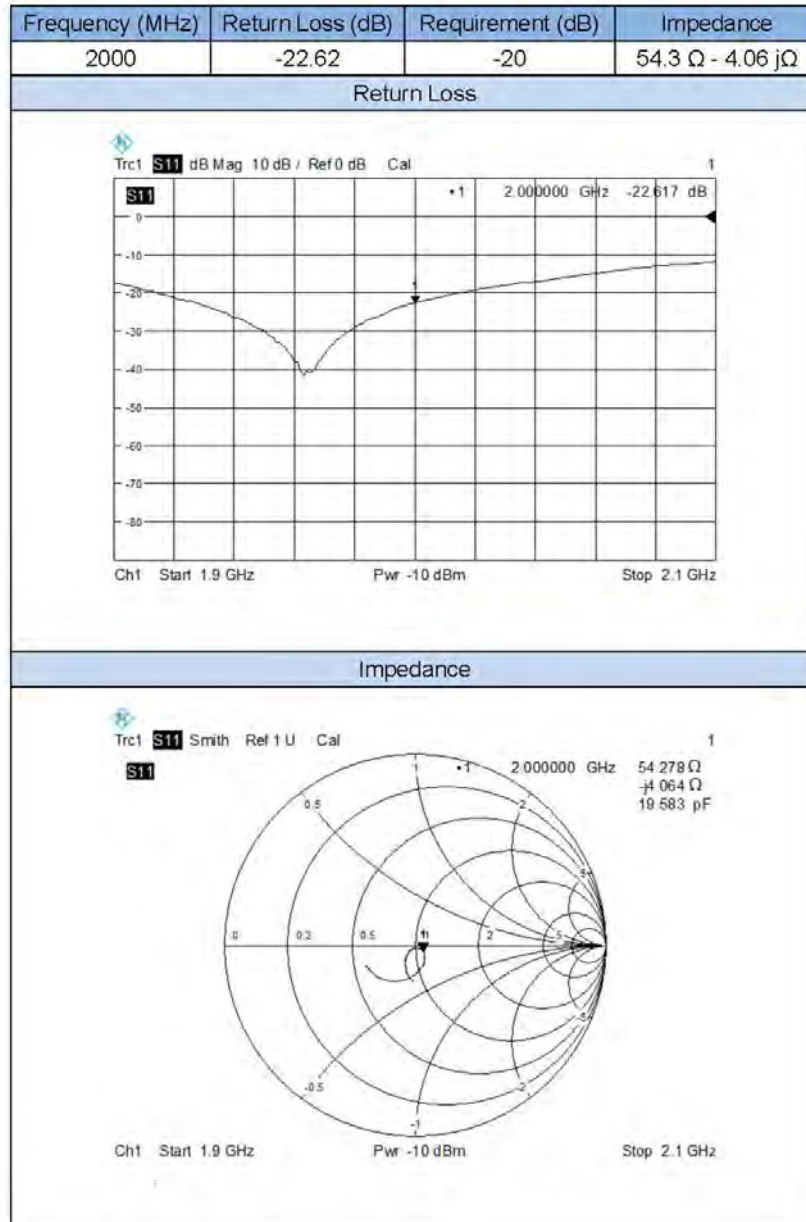
RETURN LOSS AND IMPEDANCE IN BODY LIQUID





3.7 DIP 2G000

RETURN LOSS AND IMPEDANCE IN HEAD LIQUID

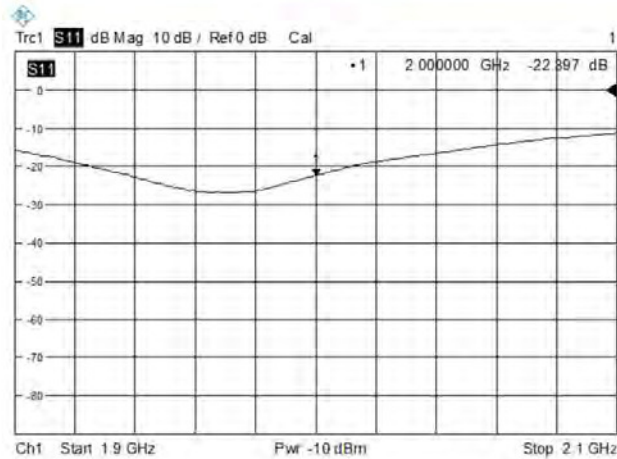




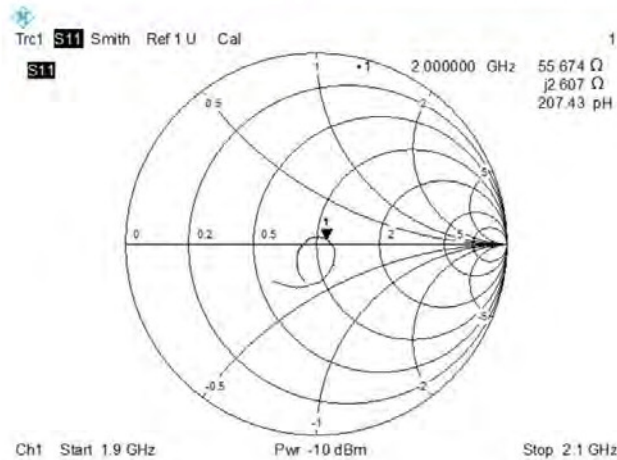
RETURN LOSS AND IMPEDANCE IN BODY LIQUID

Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2000	-22.40	-20	55.7 Ω + 2.61 j Ω

Return Loss



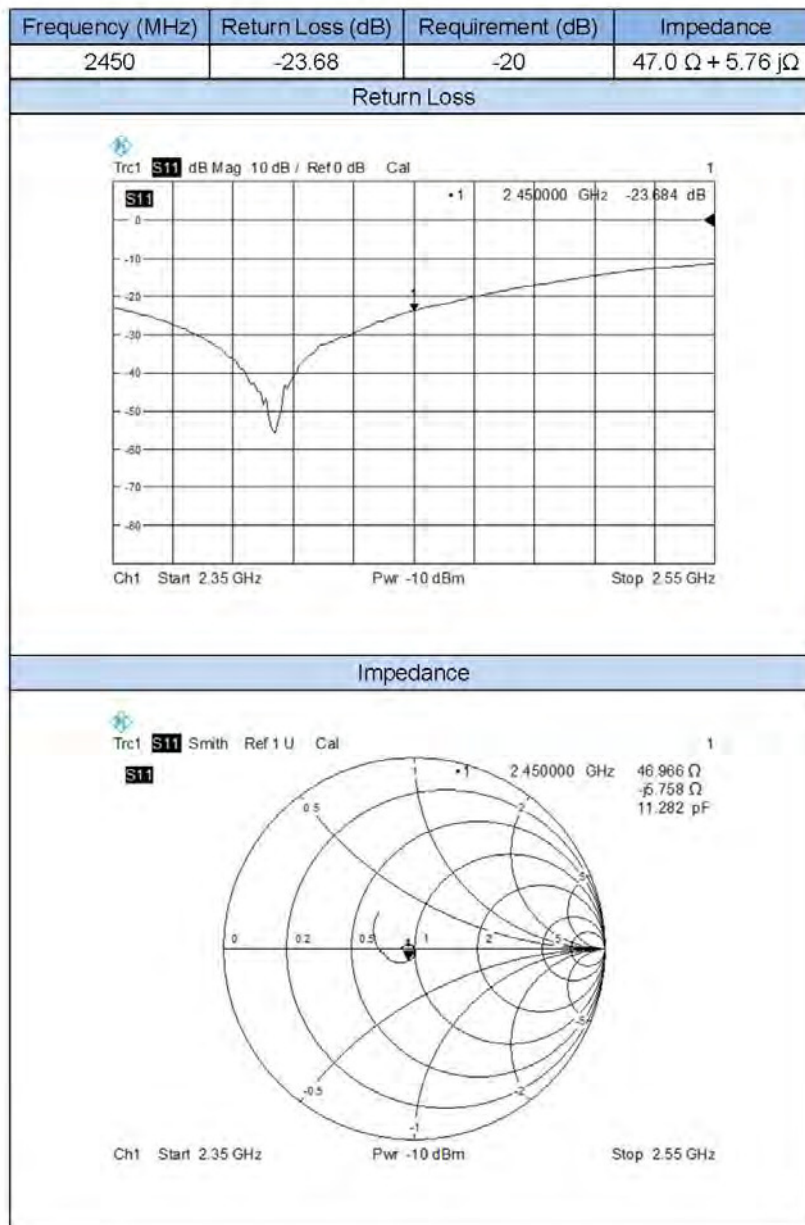
Impedance





3.8 DIP 2G450

RETURN LOSS AND IMPEDANCE IN HEAD LIQUID

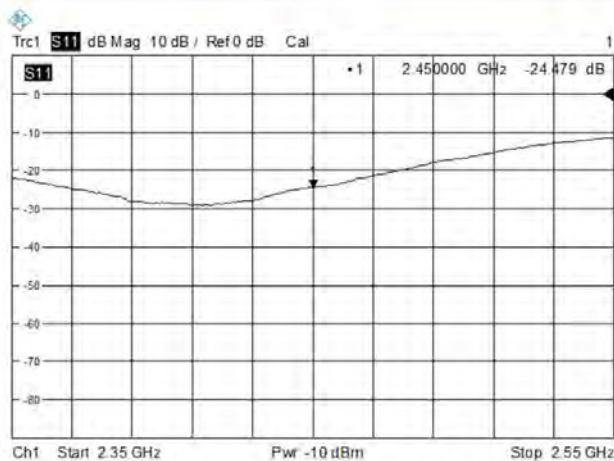




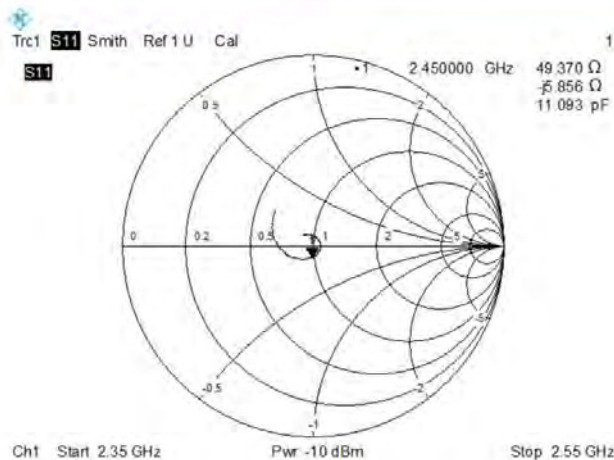
RETURN LOSS AND IMPEDANCE IN BODY LIQUID

Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2450	-24.48	-20	49.4 Ω - 5.86 j Ω

Return Loss



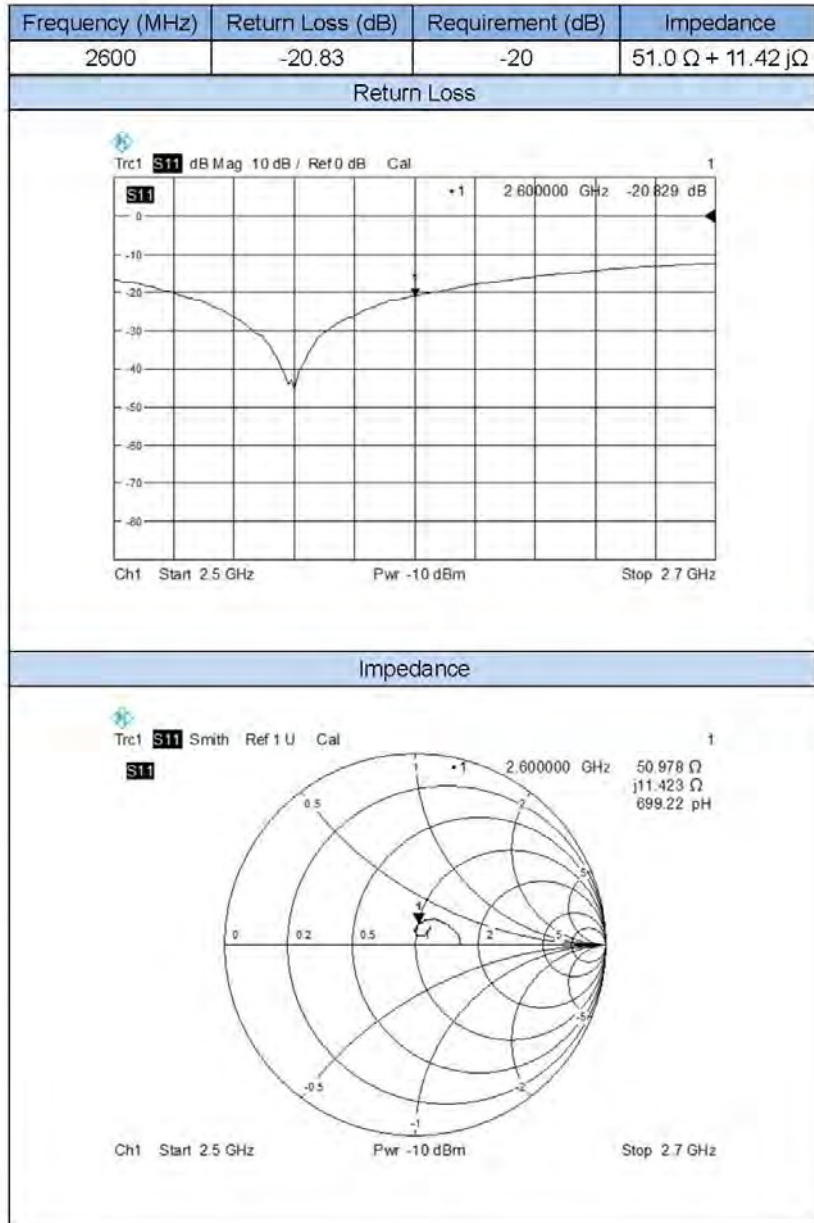
Impedance





3.9 DIP 2G600

RETURN LOSS AND IMPEDANCE IN HEAD LIQUID

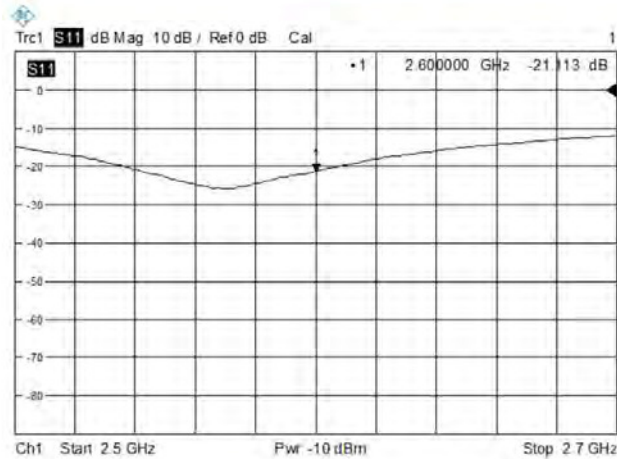




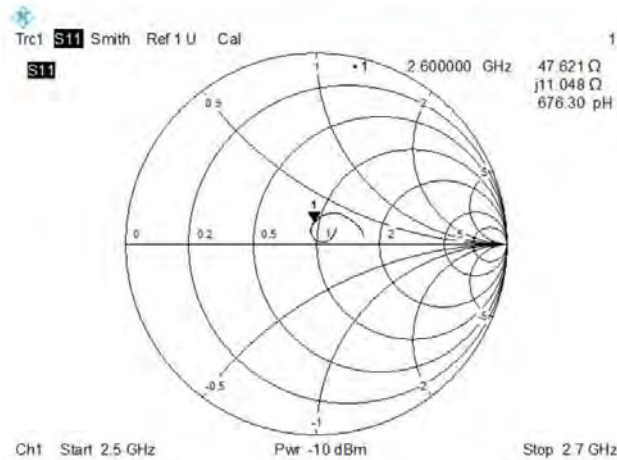
RETURN LOSS AND IMPEDANCE IN BODY LIQUID

Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2600	-21.11	-20	47.6 Ω + 11.05 j Ω

Return Loss



Impedance





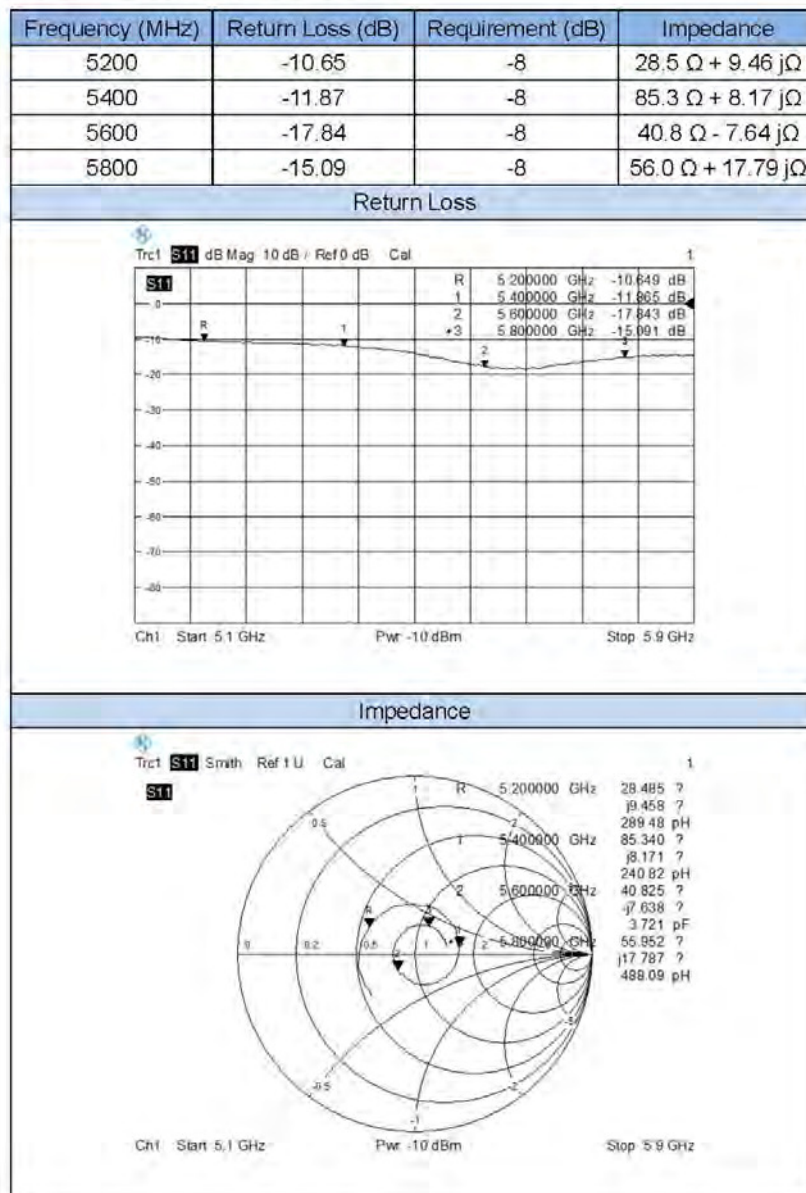
4 WAVEGUIDE IMPEDANCE AND RETURN LOSS

The waveguide are designed to have low return loss when presented against a flat phantom at the specified distance. A Vector Network Analyser was used to perform a return loss measurement on the specific waveguide when in the measurement location against the phantom and the distance was specified by the manufacturer with a special, low loss and low relative permittivity spacer.

The impedance was measured at the SMA-connector with the network analyser.

4.1 SWG5500

RETURN LOSS AND IMPEDANCE IN HEAD LIQUID

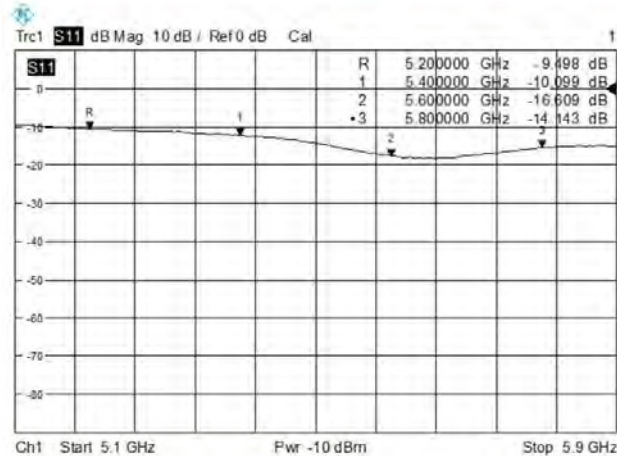




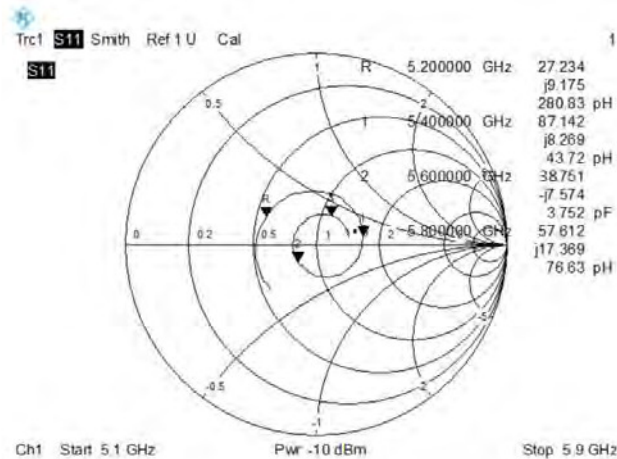
RETURN LOSS AND IMPEDANCE IN BODY LIQUID

Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
5200	-9.50	-8	$27.2 \Omega + 9.18 j\Omega$
5400	-10.10	-8	$87.1 \Omega + 8.27 j\Omega$
5600	-16.60	-8	$38.8 \Omega - 7.57 j\Omega$
5800	-14.14	-8	$57.6 \Omega + 17.37 j\Omega$

Return Loss



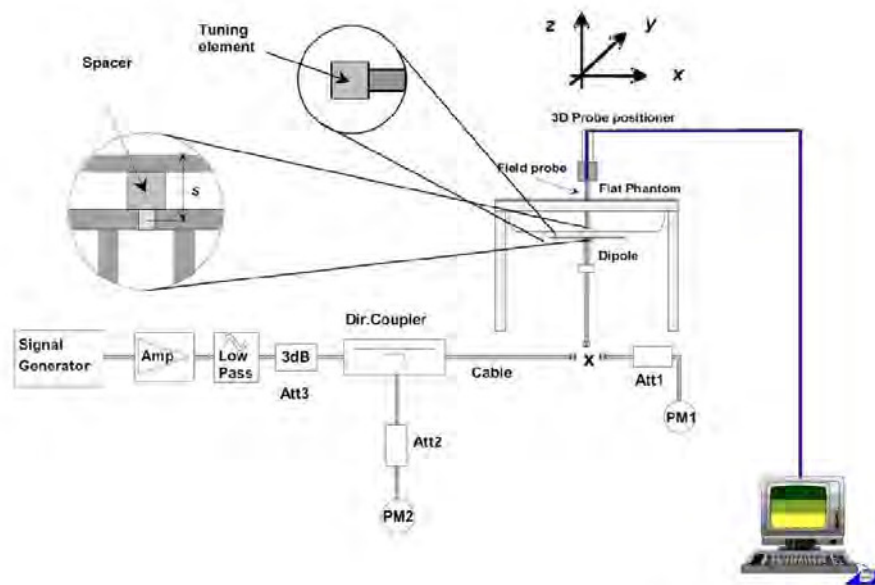
Impedance





5 VALIDATION MEASUREMENT

The IEEE Std. 1528, FCC KDBs and CEI/IEC 62209 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.





5.1 Dipole And Waveguide SAR Validation Measurement Result

Freq. (MHz)	Liquid Type	Power (mW)	1 g Measured SAR (W/kg)	Normaliz ed SAR (W/kg)	10 g Measured SAR (W/kg)	Normaliz ed SAR (W/kg)	1 g Targeted SAR (W/kg)	Tolerance (%)	10 g Targeted SAR (W/kg)	Tolerance (%)
450	Head	100	0.439	4.39	0.292	2.92	4.58	-4.15	3.06	-4.58
	Body	100	0.479	4.79	0.329	3.29	4.58	4.59	3.06	7.52
750	Head	100	0.861	8.61	0.576	5.76	8.49	1.41	5.55	3.78
	Body	100	0.879	8.79	0.592	5.92	8.49	3.53	5.55	6.67
835	Head	100	0.983	9.83	0.609	6.09	9.56	2.82	6.22	-2.09
	Body	100	1.013	10.13	0.659	6.59	9.56	5.96	6.22	5.95
900	Head	100	1.147	11.47	0.724	7.24	10.9	5.23	6.99	3.58
	Body	100	1.139	11.39	0.747	7.47	10.9	4.50	6.99	6.87
1800	Head	100	3.892	38.92	1.964	19.64	38.40	1.35	20.10	-2.29
	Body	100	3.911	39.11	1.989	19.89	38.40	1.85	20.10	-1.04
1900	Head	100	3.890	38.90	1.968	19.68	39.70	-2.02	20.50	-4.00
	Body	100	3.943	39.43	2.001	20.01	39.70	-0.68	20.50	-2.39
2000	Head	100	4.029	40.29	2.094	20.94	41.10	-1.97	21.10	-0.76
	Body	100	4.197	41.97	2.185	21.85	41.10	2.12	21.10	3.55
2450	Head	100	5.328	53.28	2.483	24.83	52.40	1.68	24.00	3.46
	Body	100	5.094	50.94	2.450	24.50	52.40	-2.79	24.00	2.08
2600	Head	100	5.323	53.23	2.515	25.15	55.30	-3.74	24.60	2.24
	Body	100	5.174	51.74	2.377	23.77	55.30	-6.44	24.60	-3.37
5200	Head	100	15.378	153.78	5.463	54.62	159.00	-3.28	56.90	-4.01
	Body	100	15.224	152.24	5.341	53.41	159.00	-4.25	56.90	-6.13
5400	Head	100	15.876	158.76	5.517	55.17	166.40	-4.59	58.43	-5.58
	Body	100	15.762	157.62	5.615	56.15	166.40	-5.28	58.43	-3.90
5600	Head	100	16.475	164.75	5.792	57.92	173.80	-5.21	59.97	-3.42
	Body	100	15.813	158.13	5.645	56.45	173.80	-9.02	59.97	-5.87
5800	Head	100	17.688	176.88	5.984	59.84	181.20	-2.38	61.50	-2.70
	Body	100	16.953	169.53	5.836	58.36	181.20	-6.44	61.50	-5.11



5.2 DIP 0G450

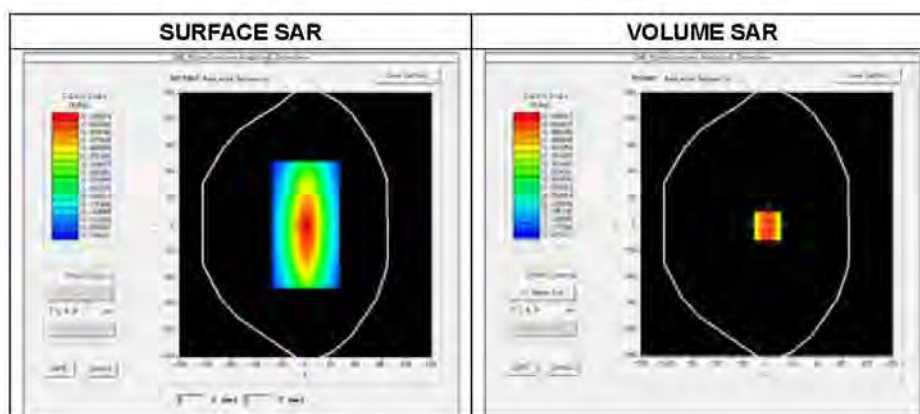
5.2.1 Dipole 450 MHz Validation Measurement for Head Tissue

System Performance Check Data(450 MHz Head)

Type: Phone measurement (Complete)
 E-Field Probe: SN 34/15 EPGO265
 Area scan resolution: dx=8mm, dy=8mm
 Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm
 Date of measurement: 2016.03.01
 Measurement duration: 14 minutes 46 seconds

Experimental conditions.

Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	450MHz
Signal	CW
Frequency (MHz)	450.000000
Relative permittivity (real part)	42.872365
Conductivity (S/m)	0.890236
Power drift (%)	1.350000
Ambient Temperature:	21.6°C
Liquid Temperature:	21.1°C
ConvF:	1.85
Crest factor:	1:1

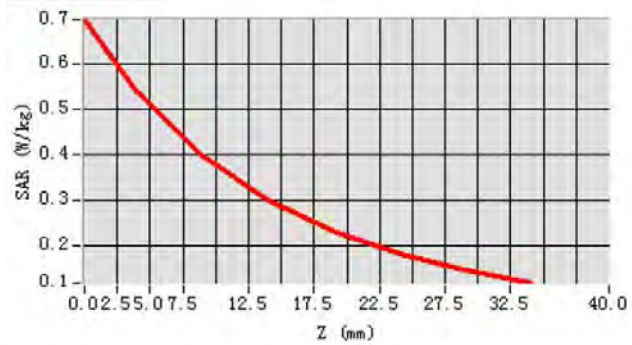




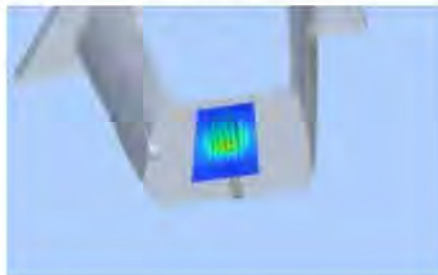
Maximum location: X=0.00, Y=0.00
SAR Peak: 0.69 W/kg

SAR 10g (W/Kg)	0.291862
SAR 1g (W/Kg)	0.439023

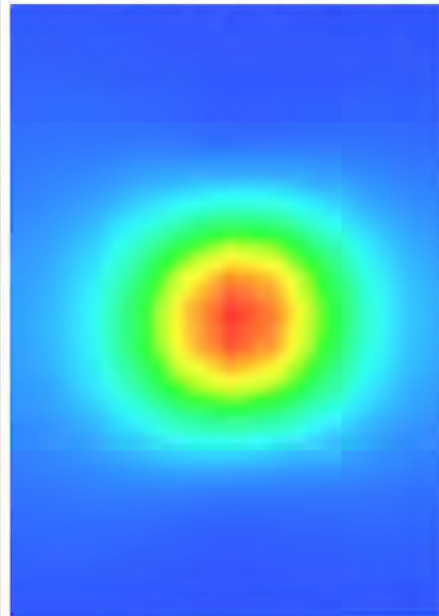
Z Axis Scan



3D screen shot



Hot spot position





5.2.2 Dipole 450 MHz Validation Measurement for Body Tissue

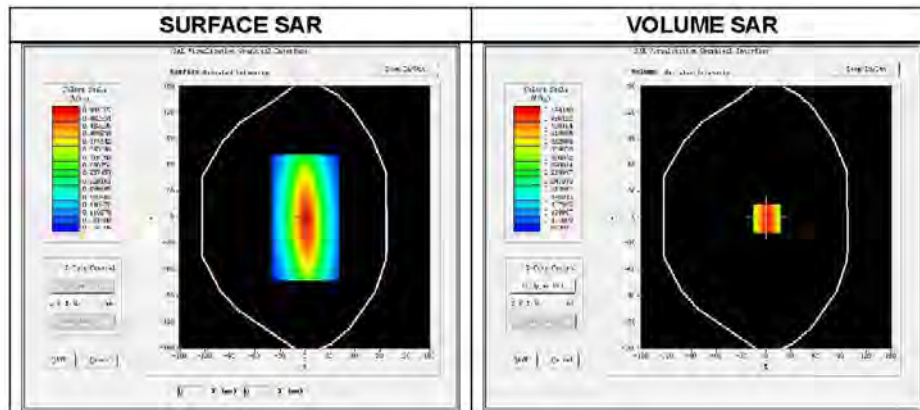
System Performance Check Data(450 MHz Body)

Type: Phone measurement (Complete)
E-Field Probe: SN 34/15 SSE2 EPGO265
Area scan resolution: dx=8mm,dy=8mm
Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm
Date of measurement: 2016.03.01
Measurement duration: 13 minutes 52 seconds

Experimental conditions.

1

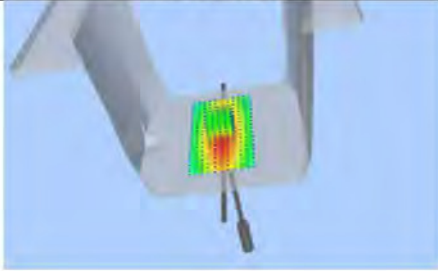
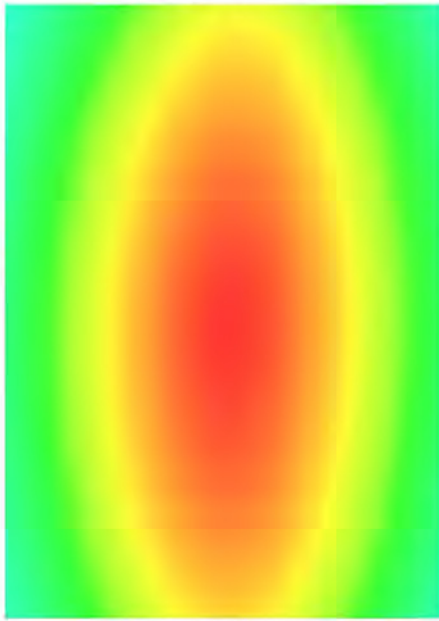
Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	450MHz
Signal	CW
Frequency (MHz)	450.000000
Relative permittivity (real part)	55.695599
Conductivity (S/m)	0.955490
Power drift (%)	-1.370000
Ambient Temperature:	21.6°C
Liquid Temperature:	21.1°C
ConvF:	1.90
Crest factor:	1:1





Maximum location: X=1.00, Y=-1.00
SAR Peak: 0.66 W/kg

SAR 10g (W/Kg)	0.328543
SAR 1g (W/Kg)	0.478689

<u>Z Axis Scan</u>	
3D scene shot	Hot spot position
	



5.3 DIP 0G750

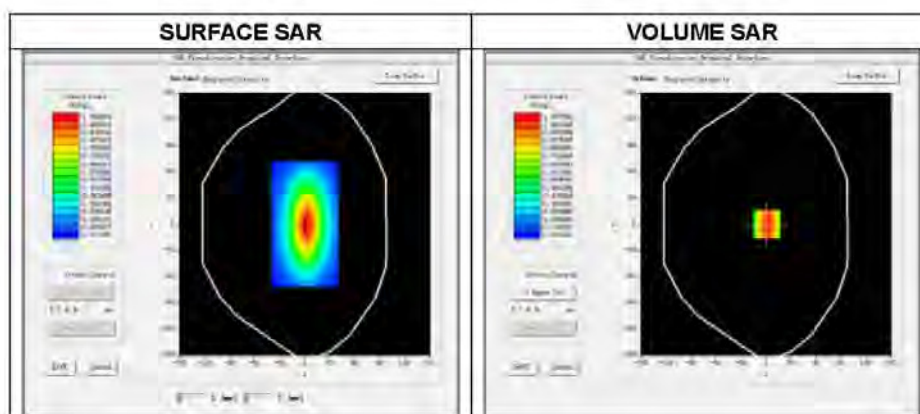
5.3.1 Dipole 750 MHz Validation Measurement for Head Tissue

System Performance Check Data(750 MHz Head)

Type: Phone measurement (Complete)
E-Field Probe: SN 34/15 SSE2 EPGO265
Area scan resolution: dx=8mm,dy=8mm
Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm
Date of measurement: 2016.03.01
Measurement duration: 13 minutes 27 seconds

Experimental conditions.

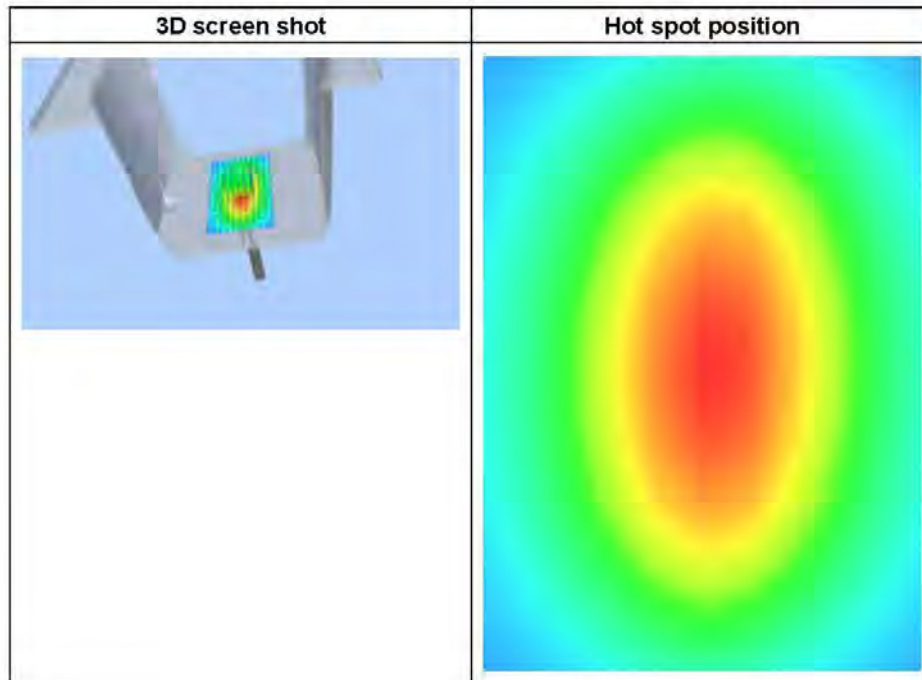
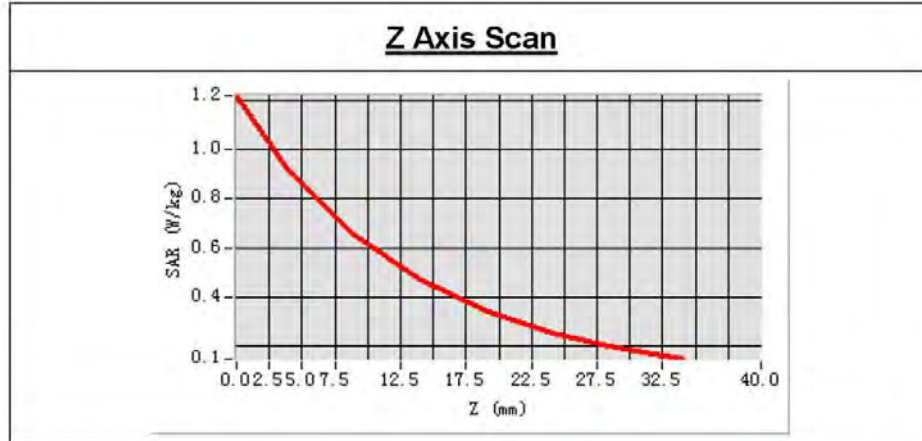
Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	750MHz
Signal	CW
Frequency (MHz)	750MHz
Relative permittivity (real part)	41.923526
Conductivity (S/m)	0.883686
Power drift (%)	-3.100000
Ambient Temperature:	21.6°C
Liquid Temperature:	21.1°C
ConvF:	1.81
Crest factor:	1:1





Maximum location: X=1.00, Y=0.00
SAR Peak: 1.28 W/kg

SAR 10g (W/Kg)	0.576457
SAR 1g (W/Kg)	0.861462





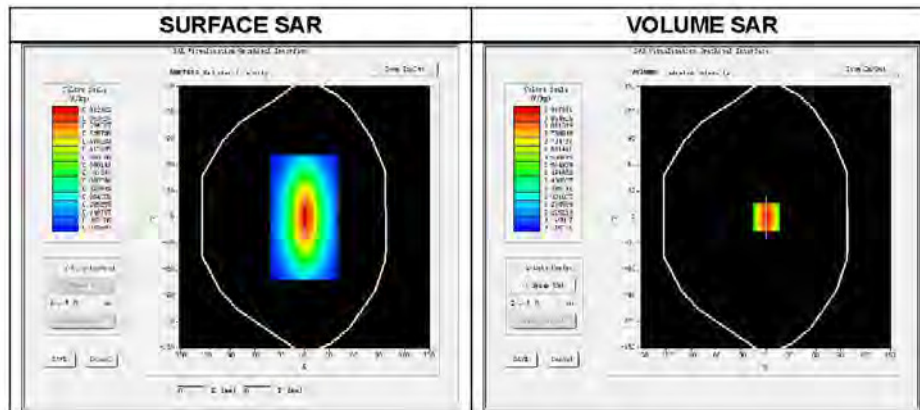
5.3.2 Dipole 750 MHz Validation Measurement for Body Tissue

System Performance Check Data(750 MHz Body)

Type: Phone measurement (Complete)
 E-Field Probe: SN 34/15 SSE2 EPGO265
 Area scan resolution: dx=8mm,dy=8mm
 Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm
 Date of measurement: 2016.03.01
 Measurement duration: 13 minutes 27 seconds

Experimental conditions.

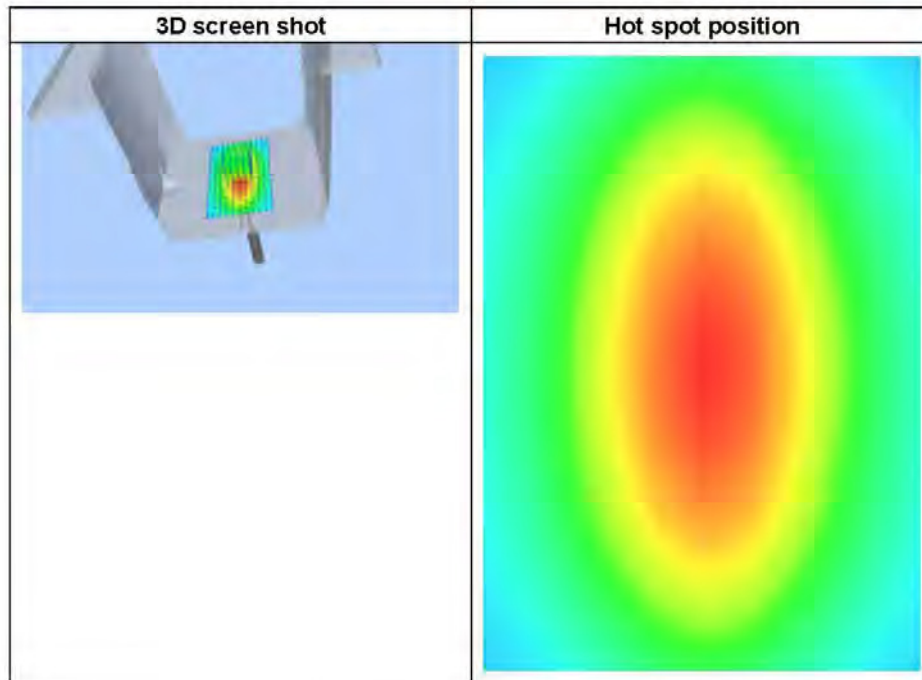
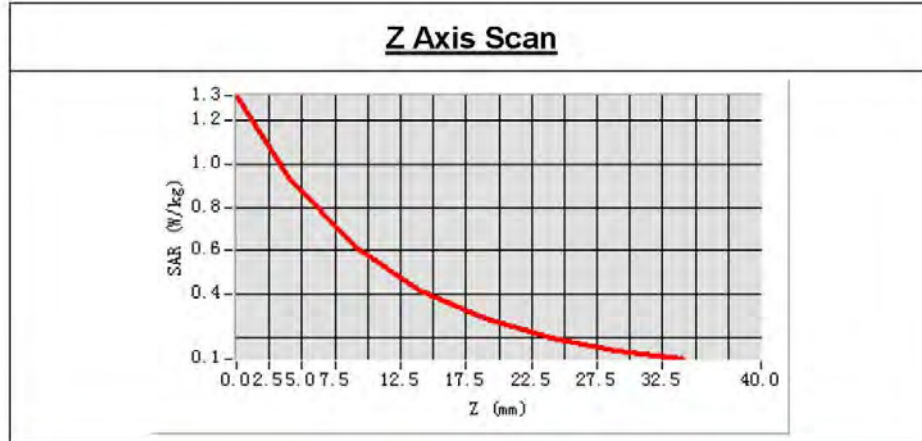
Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	750MHz
Signal	CW
Frequency (MHz)	750MHz
Relative permittivity (real part)	57.188739
Conductivity (S/m)	0.946268
Power drift (%)	-0.600000
Ambient Temperature:	21.6°C
Liquid Temperature:	21.1°C
ConvF:	1.88
Crest factor:	1:1





Maximum location: X=1.00, Y=0.00
SAR Peak: 1.28 W/kg

SAR 10g (W/Kg)	0.592395
SAR 1g (W/Kg)	0.878736





5.4 DIP 0G835

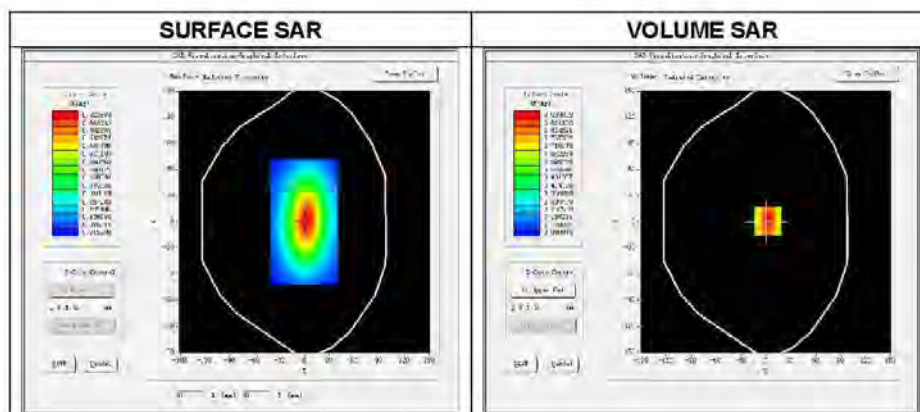
5.4.1 Dipole 835 MHz Validation Measurement for Head Tissue

System Performance Check Data(835 MHz Head)

Type: Phone measurement (Complete)
E-Field Probe: SN 34/15 SSE2 EPGO265
Area scan resolution: dx=8 mm,dy=8 mm
Zoom scan resolution: dx=8 mm, dy=8 mm, dz=5 mm
Date of measurement: 2016.03.01
Measurement duration: 14 minutes 2 seconds

Experimental conditions.

Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	835 MHz
Signal	CW
Frequency (MHz)	835.000000
Relative permittivity (real part)	43.331142
Conductivity (S/m)	0.897827
Power drift (%)	-0.050000
Ambient Temperature:	21.6°C
Liquid Temperature:	21.1°C
ConvF:	2.04
Crest factor:	1:1

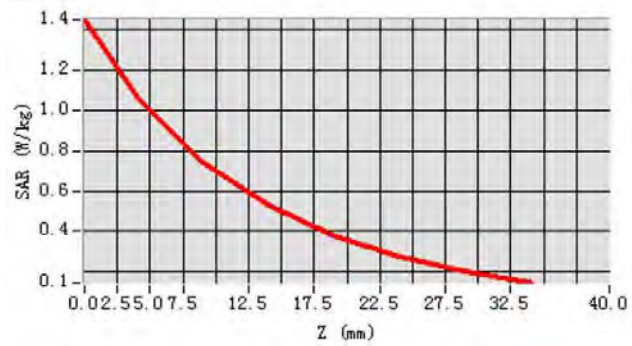




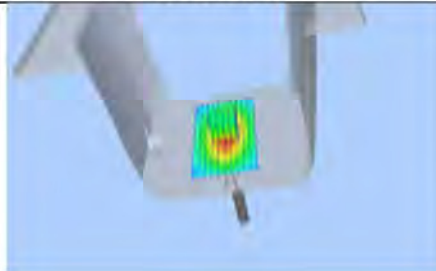
Maximum location: X=0.00, Y=0.00
SAR Peak: 1.40 W/kg

SAR 10 g (W/Kg)	0.609437
SAR 1 g (W/Kg)	0.983275

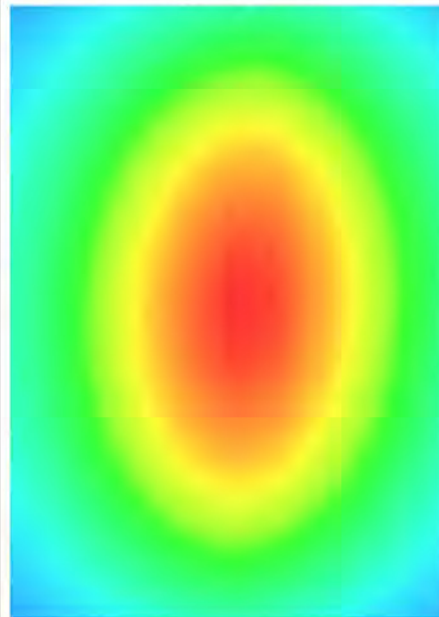
Z Axis Scan



3D screen shot



Hot spot position





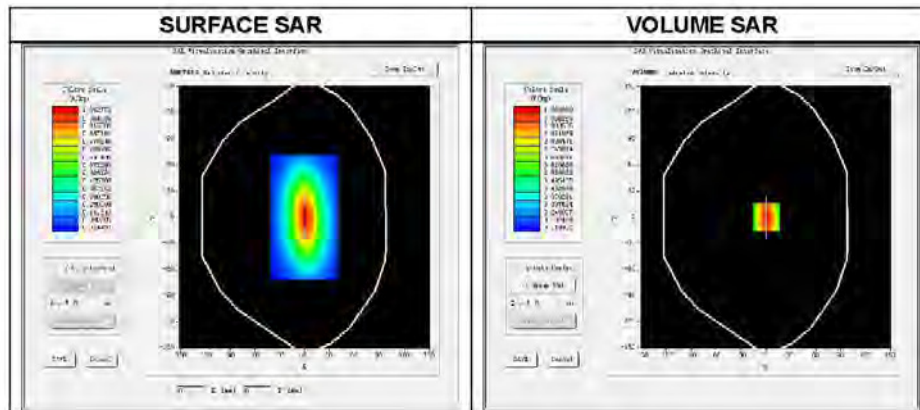
5.4.2 Dipole 835 MHz Validation Measurement for Body Tissue

System Performance Check Data(835 MHz Body)

Type: Phone measurement (Complete)
E-Field Probe: SN 34/15 SSE2 EPG0265
Area scan resolution: dx=8 mm,dy=8 mm
Zoom scan resolution: dx=8 mm, dy=8 mm, dz=5 mm
Date of measurement: 2016.03.01
Measurement duration: 14 minutes 2 seconds

Experimental conditions.

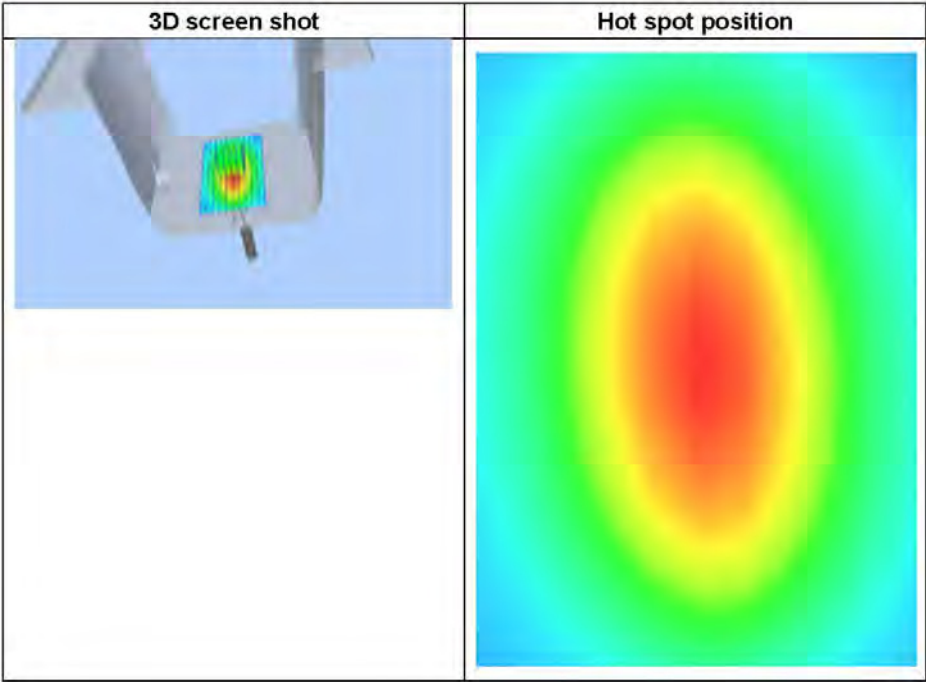
Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	835 MHz
Signal	CW
Frequency (MHz)	835.000000
Relative permittivity (real part)	54.652059
Conductivity (S/m)	0.991147
Power drift (%)	0.390000
Ambient Temperature:	21.6°C
Liquid Temperature:	21.1°C
ConvF:	2.12
Crest factor:	1:1





Maximum location: X=0.00, Y=0.00
 SAR Peak: 1.41 W/kg

SAR 10 g (W/Kg)	0.659168
SAR 1 g (W/Kg)	1.013364





5.5DIP 0G900

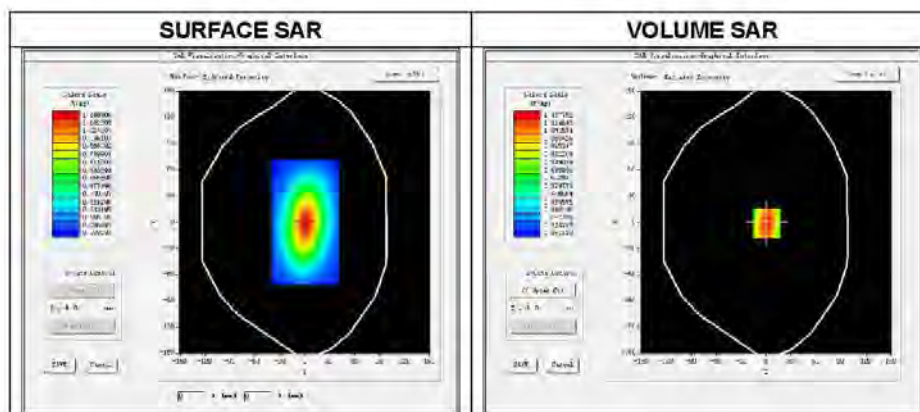
5.5.1 Dipole 900 MHz Validation Measurement for Head Tissue

System Performance Check Data(900 MHz Head)

Type: Phone measurement (Complete)
E-Field Probe: SN 34/15 SSE2 EPG0265
Area scan resolution: dx=8 mm,dy=8 mm
Zoom scan resolution: dx=8 mm, dy=8 mm, dz=5 mm
Date of measurement: 2016.03.01
Measurement duration: 13 minutes 55 seconds

Experimental conditions.

Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	900 MHz
Signal	CW
Frequency (MHz)	900.000000
Relative permittivity (real part)	41.140601
Conductivity (S/m)	0.994278
Power drift (%)	0.420000
Ambient Temperature:	21.6°C
Liquid Temperature:	21.1°C
ConvF:	1.86
Crest factor:	1:1

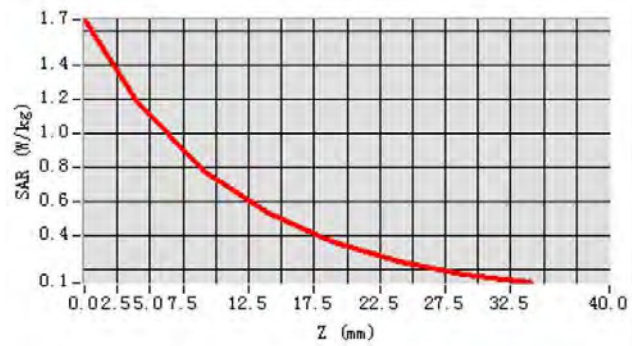




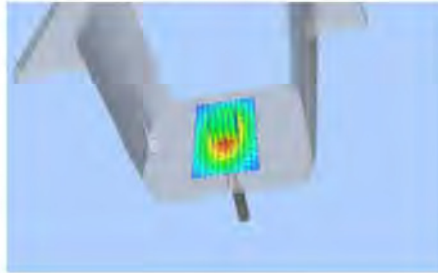
Maximum location: X=0.00, Y=0.00
SAR Peak: 1.66 W/kg

SAR 10 g (W/Kg)	0.723554
SAR 1 g (W/Kg)	1.147184

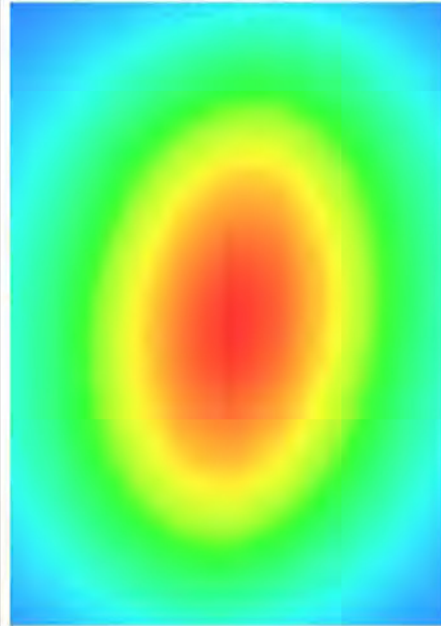
Z Axis Scan



3D screen shot



Hot spot position





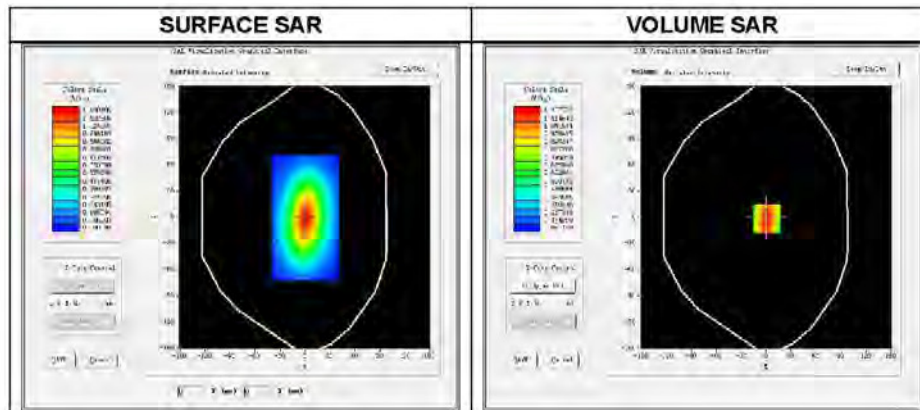
5.5.2 Dipole 900 MHz Validation Measurement for Body Tissue

System Performance Check Data(900 MHz Body)

Type: Phone measurement (Complete)
E-Field Probe: SN 34/15 SSE2 EPGO265
Area scan resolution: dx=8 mm,dy=8 mm
Zoom scan resolution: dx=8 mm, dy=8 mm, dz=5 mm
Date of measurement: 2016.03.01
Measurement duration: 13 minutes 55 seconds

Experimental conditions.

Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	900 MHz
Signal	CW
Frequency (MHz)	900.000000
Relative permittivity (real part)	54.932917
Conductivity (S/m)	1.062623
Power drift (%)	-0.290000
Ambient Temperature:	21.6°C
Liquid Temperature:	21.1°C
ConvF:	1.92
Crest factor:	1:1



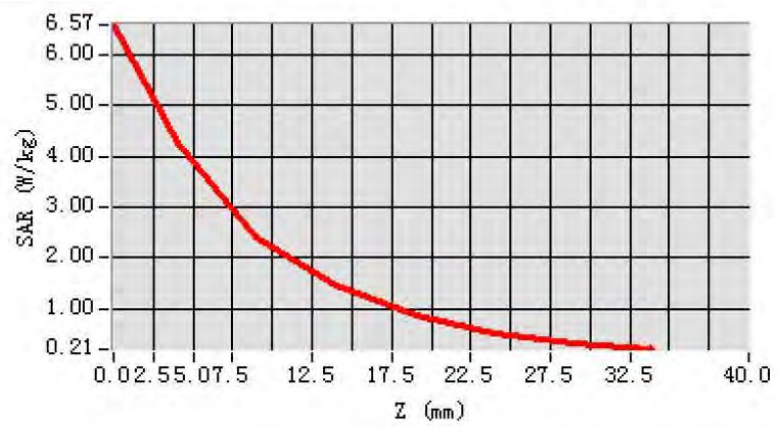


Maximum location: X=0.00, Y=0.00

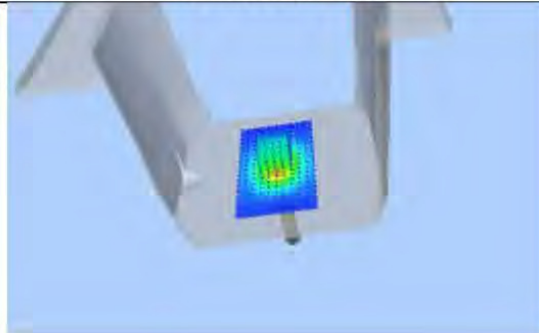
SAR Peak: 6.52 W/kg

SAR 10 g (W/Kg)	1.989471
SAR 1g (W/Kg)	3.911256

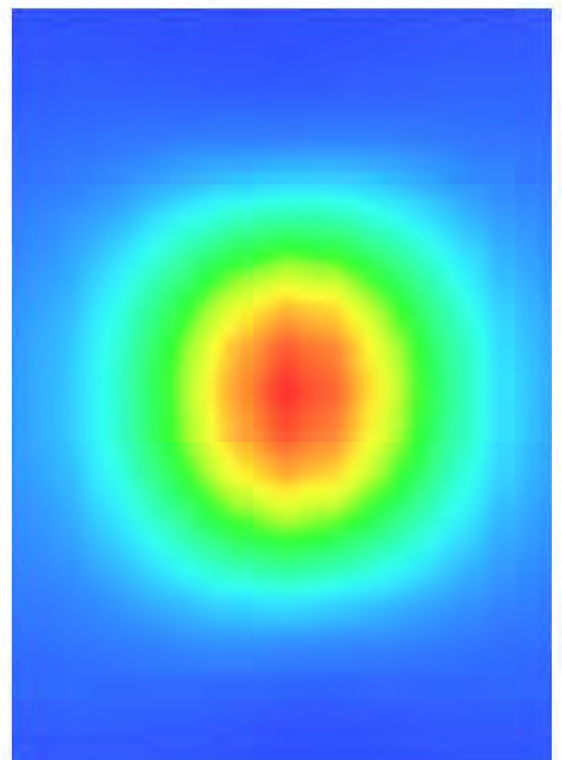
Z Axis Scan



3D screen shot



Hot spot position





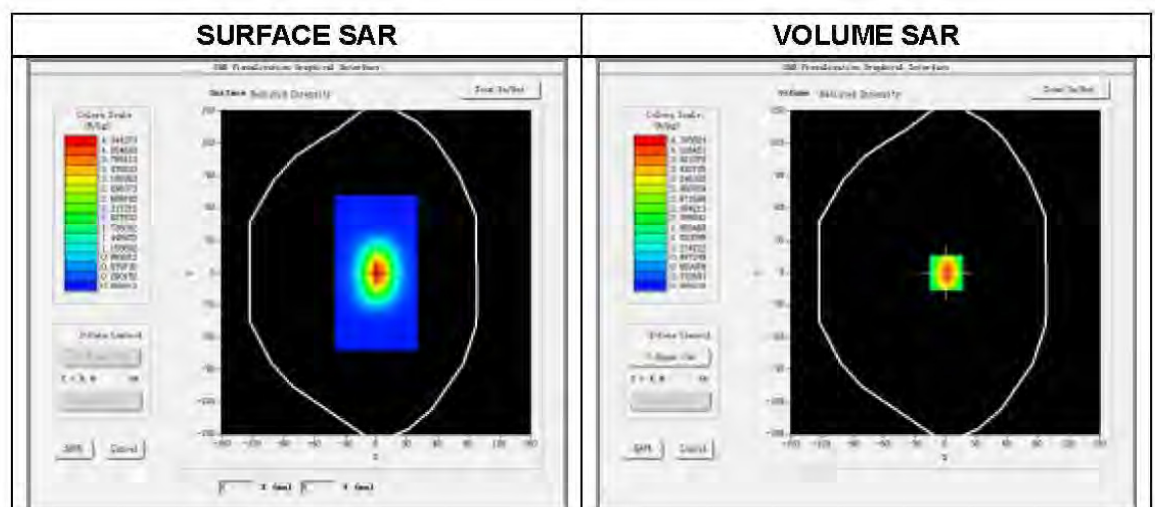
5.6.2 Dipole 1800 MHz Validation Measurement for Body Tissue

System Performance Check Data(1800 MHz Body)

Type: Phone measurement (Complete)
E-Field Probe: SN 34/15 SSE2 EPGO265
Area scan resolution: dx=8mm,dy=8mm
Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm
Date of measurement: 2016.03.02
Measurement duration: 13 minutes 27 seconds

Experimental conditions.

Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	1800MHz
Signal	CW
Frequency (MHz)	1800.000000
Relative permittivity (real part)	54.685214
Conductivity (S/m)	1.508863
Power drift (%)	1.160000
Ambient Temperature:	21.6°C
Liquid Temperature:	21.1°C
ConvF:	2.08
Crest factor:	1.1



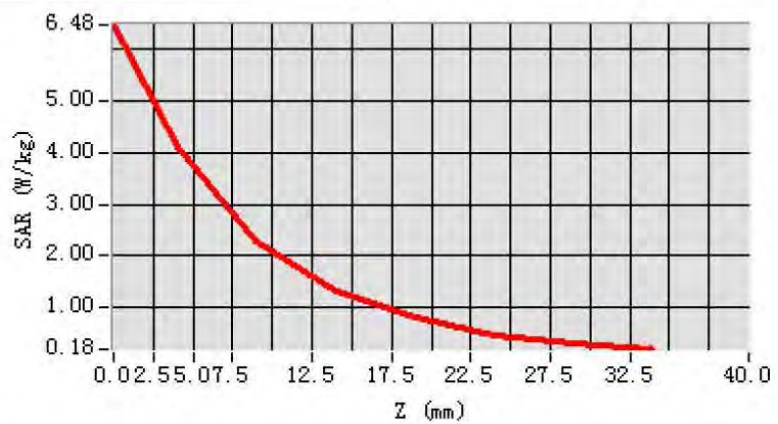


Maximum location: X=0.00, Y=0.00

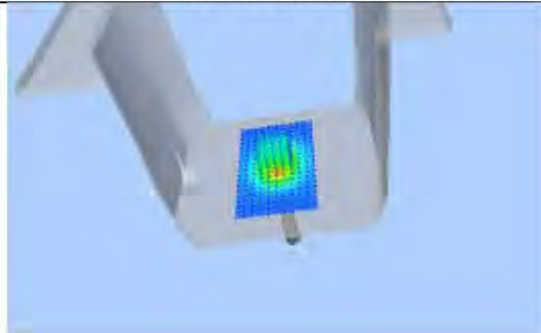
SAR Peak: 6.47 W/kg

SAR 10 g (W/Kg)	1.964125
SAR 1g (W/Kg)	3.892053

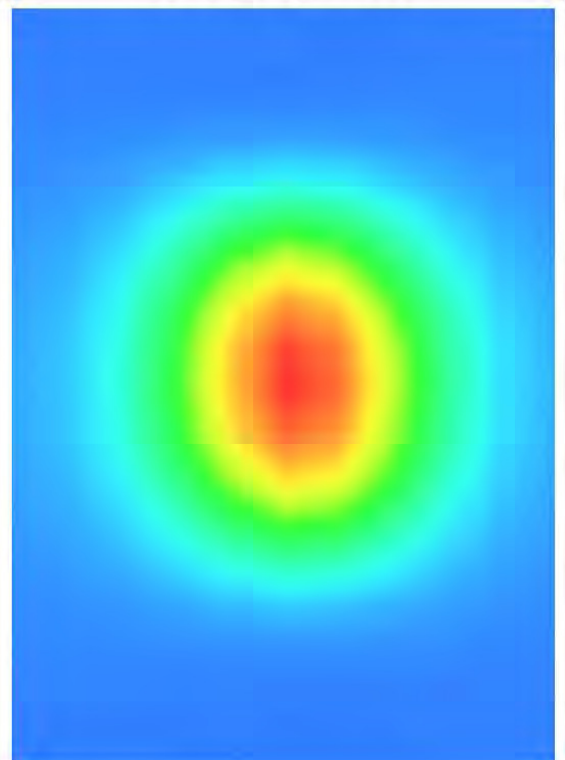
Z Axis Scan



3D screen shot



Hot spot position





5.6 DIP 1G800

5.6.1 Dipole 1800 MHz Validation Measurement for Head Tissue

System Performance Check Data(1800 MHz Head)

Type: Phone measurement (Complete)

E-Field Probe: SN 34/15 SSE2 EPGO265

Area scan resolution: dx=8mm,dy=8mm

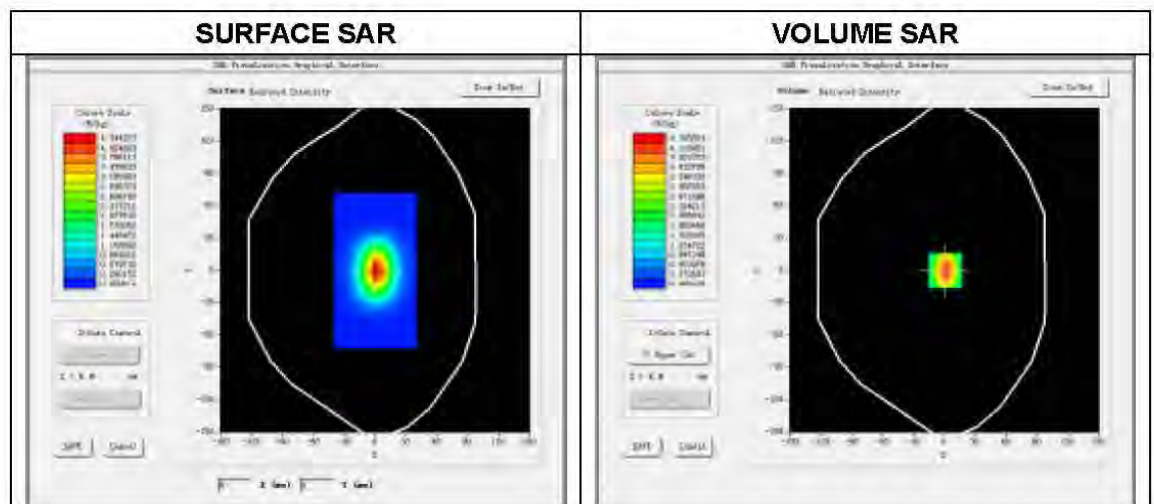
Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm

Date of measurement: 2016.03.02

Measurement duration: 13 minutes 27 seconds

Experimental conditions.

Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	1800MHz
Signal	CW
Frequency (MHz)	1800.000000
Relative permittivity (real part)	39.562781
Conductivity (S/m)	1.413274
Power drift (%)	1.160000
Ambient Temperature:	21.6°C
Liquid Temperature:	21.1°C
ConvF:	2.04
Crest factor:	1.1

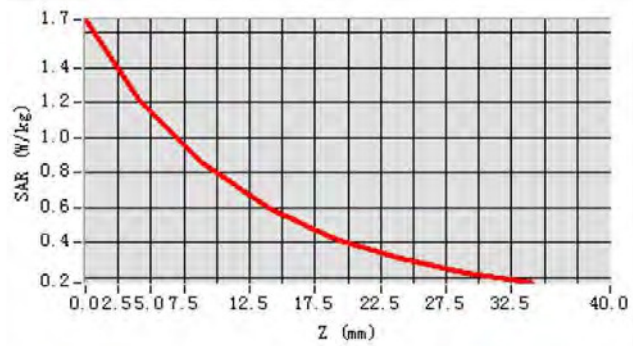




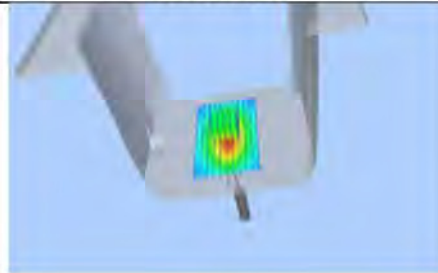
Maximum location: X=0.00, Y=0.00
SAR Peak: 1.67 W/kg

SAR 10 g (W/Kg)	0.746807
SAR 1 g (W/Kg)	1.139340

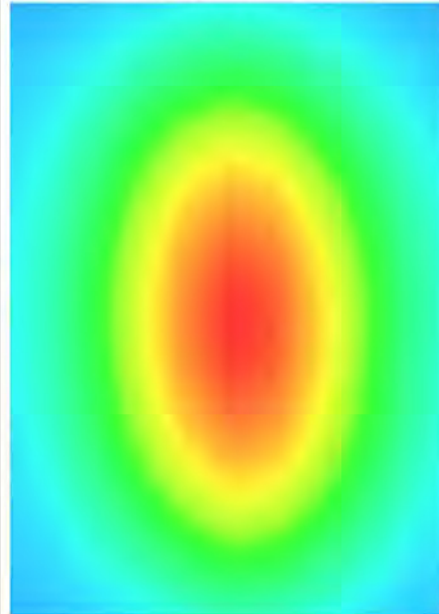
Z Axis Scan



3D screen shot



Hot spot position





5.7 DIP 1G900

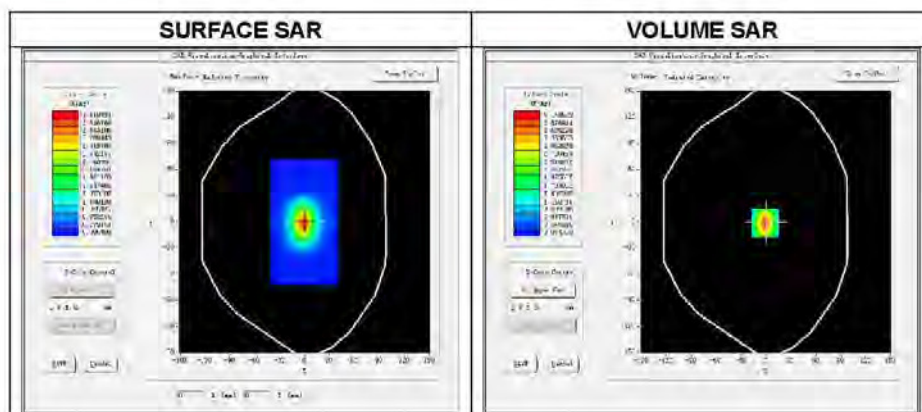
5.7.1 Dipole 1900 MHz Validation Measurement for Head Tissue

System Performance Check Data(1900 MHz Head)

Type: Phone measurement (Complete)
E-Field Probe: SN 34/15 SSE2 EPGO265
Area scan resolution: dx=8mm,dy=8mm
Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm
Date of measurement: 2016.03.02
Measurement duration: 13 minutes 20 seconds

Experimental conditions.

Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	1900MHz
Signal	CW
Frequency (MHz)	1900.000000
Relative permittivity (real part)	39.402471
Conductivity (S/m)	1.425793
Power drift (%)	1.260000
Ambient Temperature:	21.8°C
Liquid Temperature:	21.2°C
ConvF:	2.35
Crest factor:	1.1

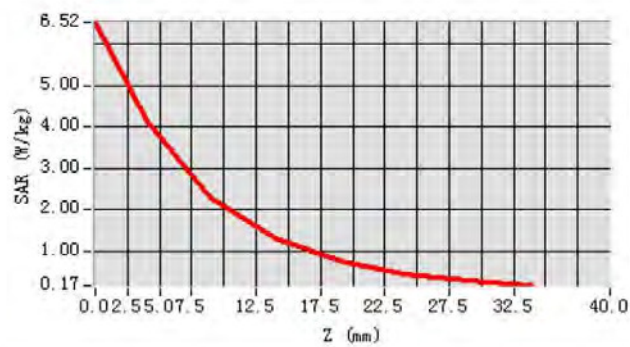




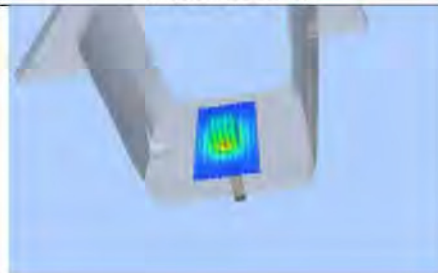
Maximum location: X=0.00, Y=0.00
SAR Peak: 6.46W/kg

SAR 10g (W/Kg)	1.967525
SAR 1g (W/Kg)	3.890170

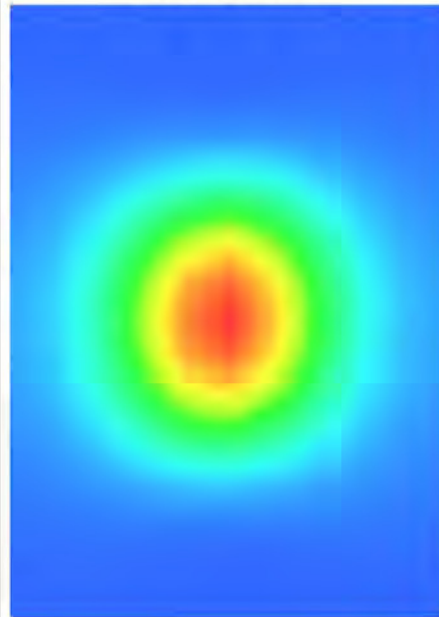
Z Axis Scan



3D screen shot



Hot spot position





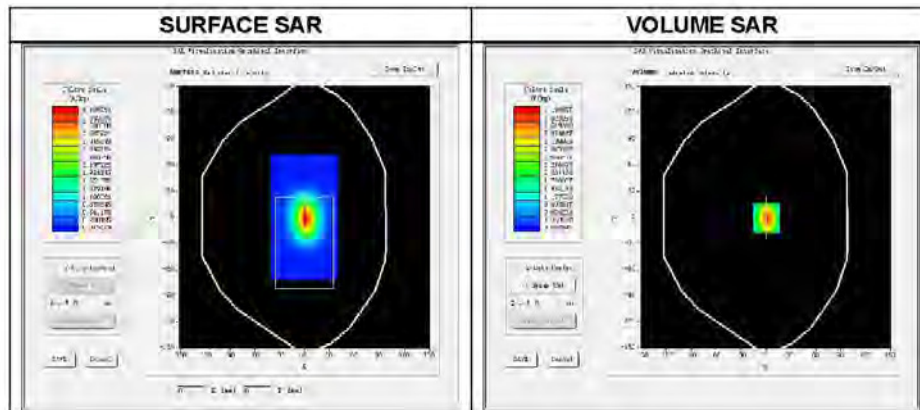
5.7.2 Dipole 1900 MHz Validation Measurement for Body Tissue

System Performance Check Data(1900 MHz Body)

Type: Phone measurement (Complete)
E-Field Probe: SN 34/15 SSE2 EPGO265
Area scan resolution: dx=8mm,dy=8mm
Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm
Date of measurement: 2016.03.02
Measurement duration: 13 minutes 20 seconds

Experimental conditions.

Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	1900 MHz
Signal	CW
Frequency (MHz)	1900.000000
Relative permittivity (real part)	53.158287
Conductivity (S/m)	1.534258
Power drift (%)	0.180000
Ambient Temperature:	21.8°C
Liquid Temperature:	21.2°C
ConvF:	2.42
Crest factor:	1:1

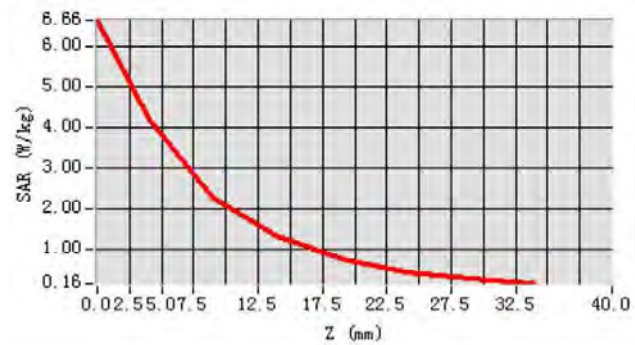




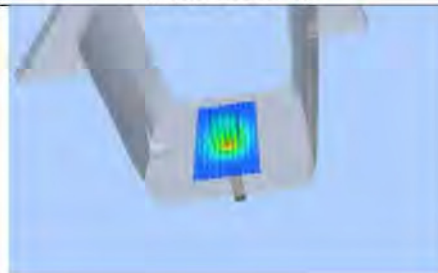
Maximum location: X=0.00, Y=0.00
SAR Peak: 6.64W/kg

SAR 10g (W/Kg)	2.001651
SAR 1g (W/Kg)	3.943225

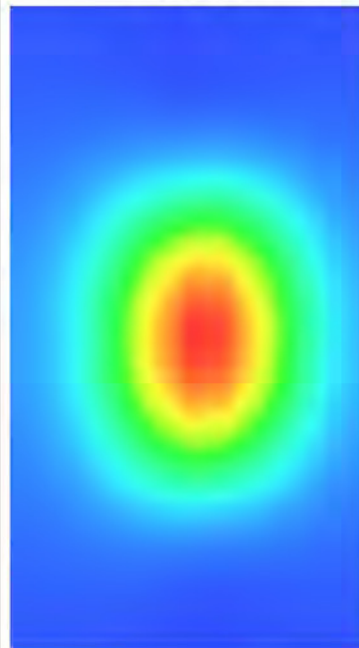
Z Axis Scan



3D screen shot



Hot spot position





5.8 DIP 2G000

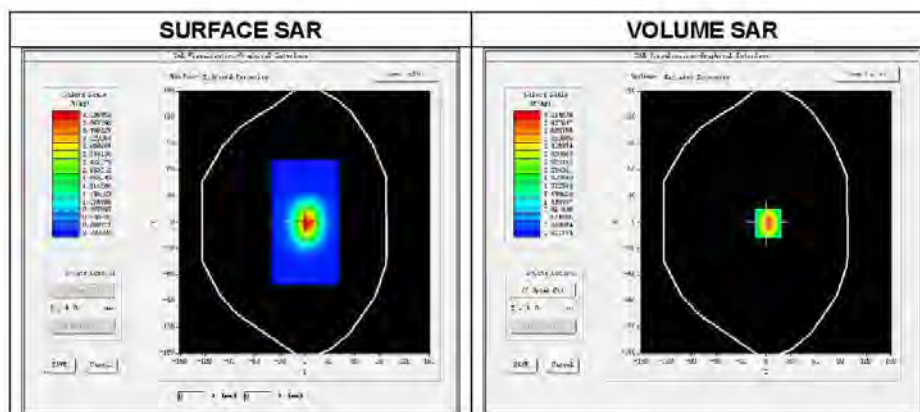
5.8.1 Dipole 2000 MHz Validation Measurement for Head Tissue

System Performance Check Data(2000 MHz Head)

Type: Phone measurement (Complete)
E-Field Probe: SN 34/15 SSE2 EPGO265
Area scan resolution: dx=8 mm,dy=8 mm
Zoom scan resolution: dx=8 mm, dy=8 mm, dz=5 mm
Date of measurement: 2016.03.02
Measurement duration: 14 minutes 17 seconds

Experimental conditions.

Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	2000 MHz
Signal	CW
Frequency (MHz)	2000.000000
Relative permittivity (real part)	38.957269
Conductivity (S/m)	1.426154
Power drift (%)	1.20000
Ambient Temperature:	21.8°C
Liquid Temperature:	21.2°C
ConvF:	2.23
Crest factor:	1.1

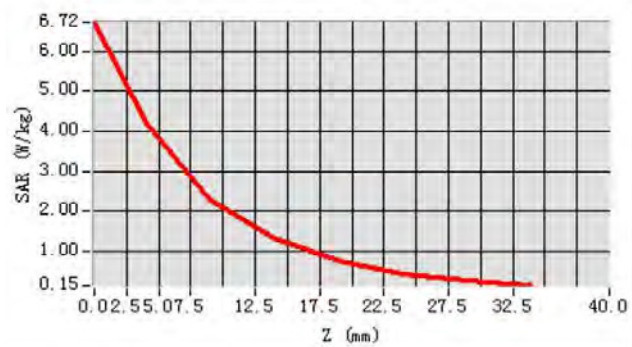




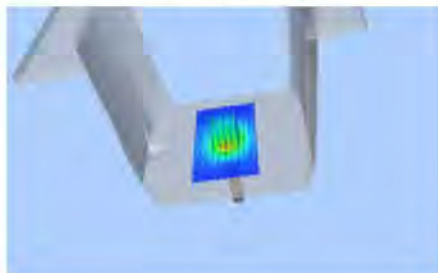
Maximum location: X=0.00, Y=0.00
SAR Peak: 6.69 W/kg

SAR 10 g (W/Kg)	2.094211
SAR 1 g (W/Kg)	4.029382

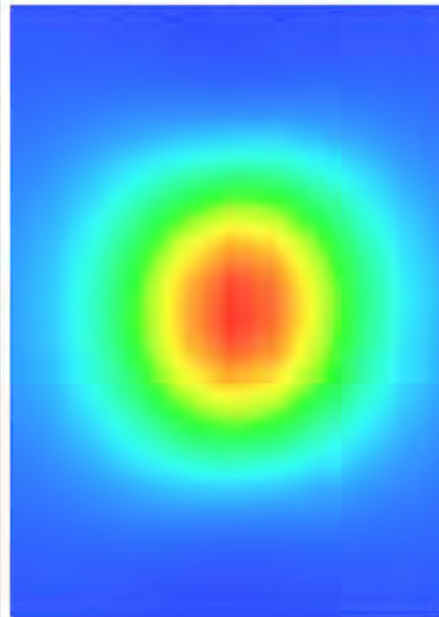
Z Axis Scan



3D screen shot



Hot spot position





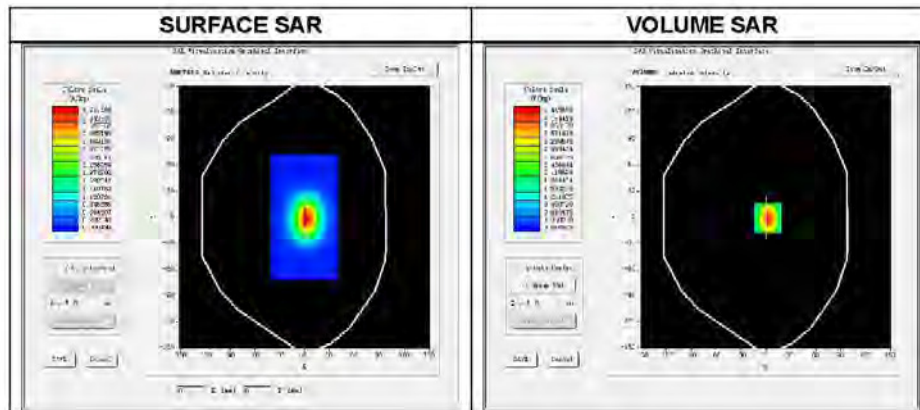
5.8.2 Dipole 2000 MHz Validation Measurement for Body Tissue

System Performance Check Data(2000 MHz Body)

Type: Phone measurement (Complete)
 E-Field Probe: SN 34/15 SSE2 EPGO265
 Area scan resolution: dx=8 mm,dy=8 mm
 Zoom scan resolution: dx=8 mm, dy=8 mm, dz=5 mm
 Date of measurement: 2016.03.02
 Measurement duration: 14 minutes 17 seconds

Experimental conditions.

Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	2000 MHz
Signal	CW
Frequency (MHz)	2000.000000
Relative permittivity (real part)	51.526653
Conductivity (S/m)	1.551869
Power drift (%)	0.380000
Ambient Temperature:	21.8°C
Liquid Temperature:	21.2°C
ConvF:	2.32
Crest factor:	1:1

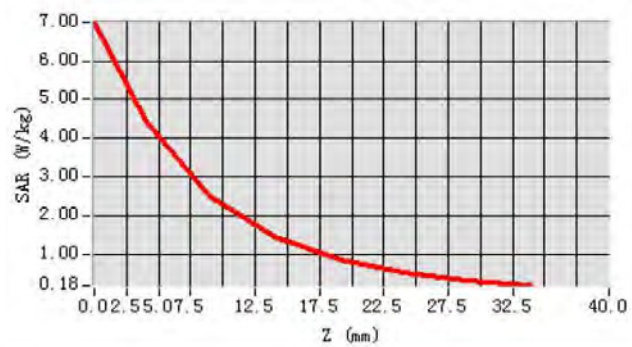




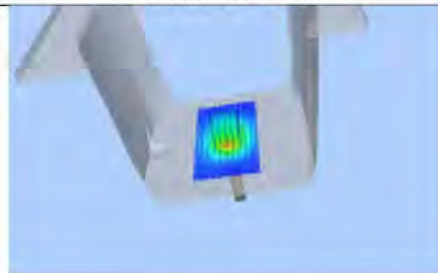
Maximum location: X=0.00, Y=0.00
SAR Peak: 6.97 W/kg

SAR 10 g (W/Kg)	2.185249
SAR 1 g (W/Kg)	4.196616

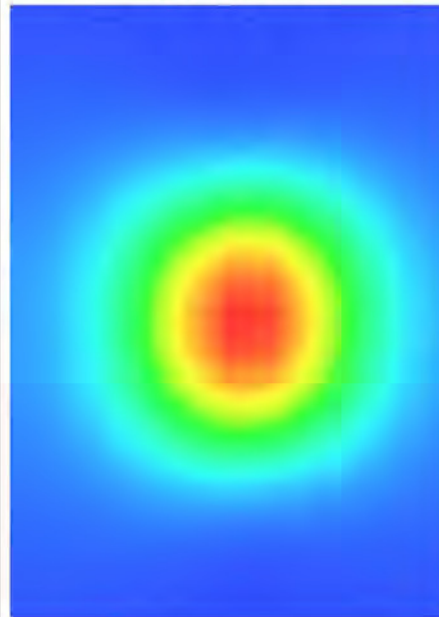
Z Axis Scan



3D screen shot



Hot spot position





5.9 DIP 2G450

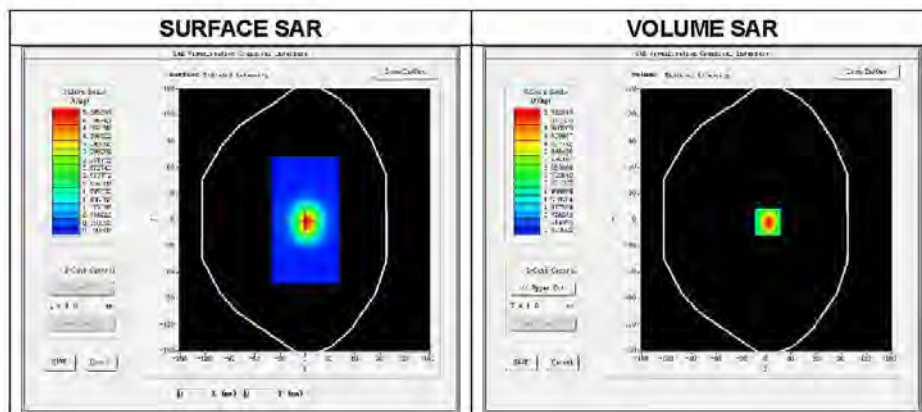
5.9.1 Dipole 2450 MHz Validation Measurement for Head Tissue

System Performance Check Data(2450 MHz Head)

Type: Phone measurement (Complete)
 E-Field Probe: SN 34/15 SSE2 EPGO265
 Area scan resolution: dx=8mm,dy=8mm
 Zoom scan resolution: dx=5mm, dy=5mm, dz=5mm
 Date of measurement: 2016.03.02
 Measurement duration: 18 minutes 47 seconds

Experimental conditions.

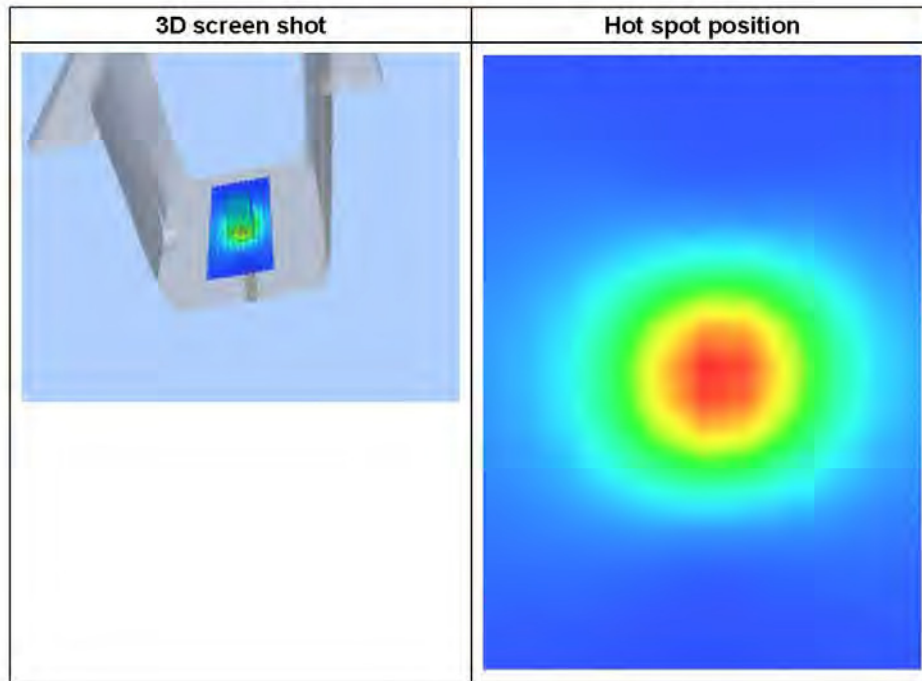
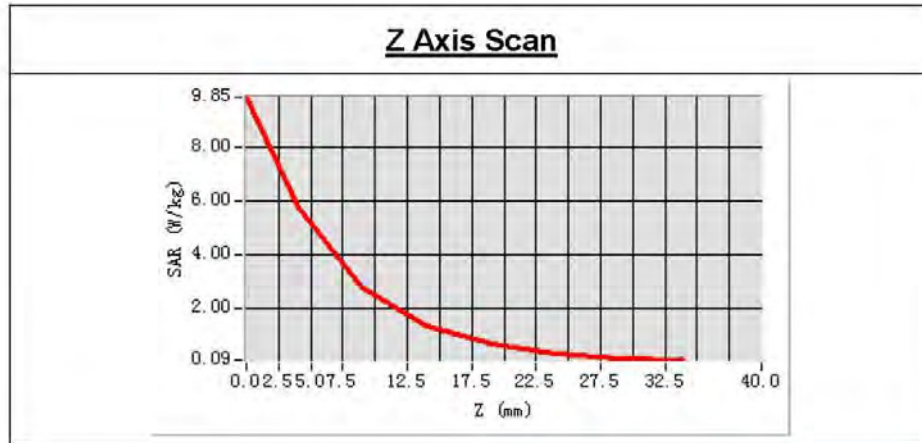
Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	2450MHz
Signal	CW
Frequency (MHz)	2450.000000
Relative permittivity (real part)	38.916950
Conductivity (S/m)	1.816079
Power drift (%)	2.570000
Ambient Temperature:	21.8°C
Liquid Temperature:	21.2°C
ConvF:	2.47
Crest factor:	1.1





Maximum location: X=0.00, Y=0.00
SAR Peak: 9.52 W/kg

SAR 10g (W/Kg)	2.483244
SAR 1g (W/Kg)	5.328480





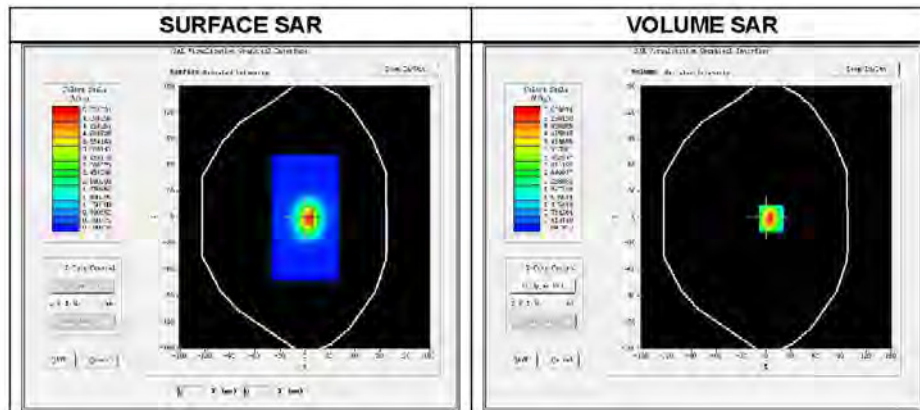
5.9.2 Dipole 2450 MHz Validation Measurement for Body Tissue

System Performance Check Data(2450 MHz Body)

Type: Phone measurement (Complete)
E-Field Probe: SN 34/15 SSE2 EPGO265
Area scan resolution: dx=8 mm,dy=8 mm
Zoom scan resolution: dx=5 mm, dy=5 mm, dz=5 mm
Date of measurement: 2016.03.02
Measurement duration: 19 minutes 58 seconds

Experimental conditions.

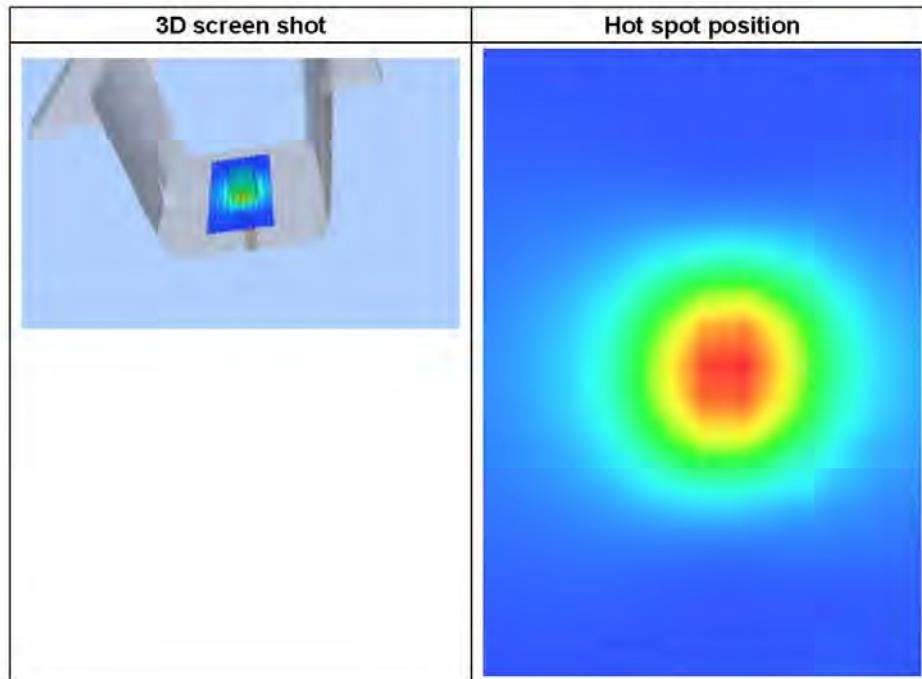
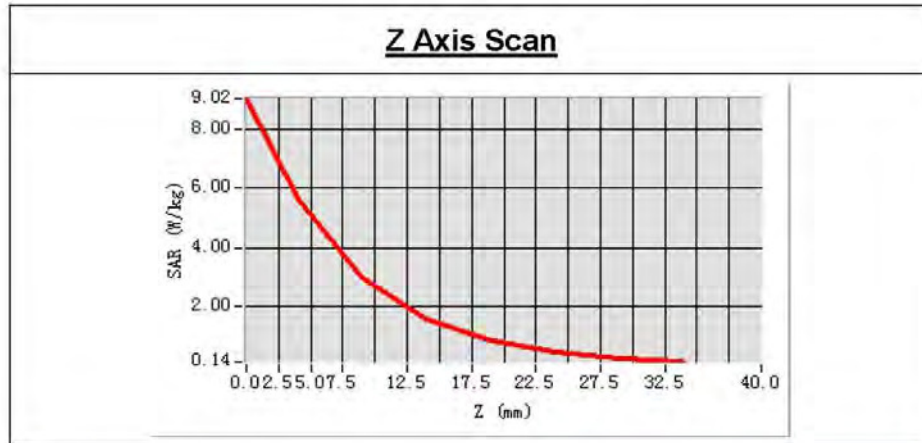
Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	2450 MHz
Signal	CW
Frequency (MHz)	2450.000000
Relative permittivity (real part)	52.962515
Conductivity (S/m)	1.960472
Power drift (%)	-0.560000
Ambient Temperature:	21.8°C
Liquid Temperature:	21.2°C
ConvF:	2.55
Crest factor:	1:1





Maximum location: X=0.00, Y=0.00
SAR Peak: 9.02 W/kg

SAR 10 g (W/Kg)	2.450144
SAR 1 g (W/Kg)	5.094052





5.10DIP 2G600

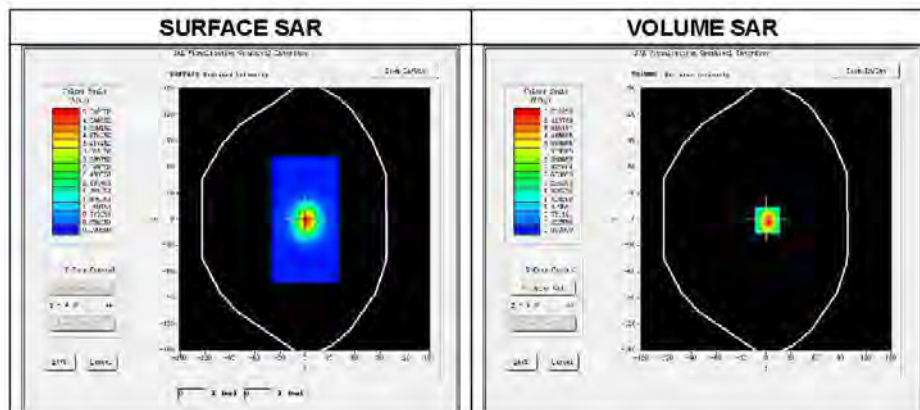
5.10.1 Dipole 2600 MHz Validation Measurement for Head Tissue

System Performance Check Data(2600 MHz Head)

Type: Phone measurement (Complete)
E-Field Probe: SN 34/15 SSE2 EPGO265
Area scan resolution: dx=8 mm,dy=8 mm
Zoom scan resolution: dx=5 mm, dy=5 mm, dz=5 mm
Date of measurement: 2016.03.03
Measurement duration: 19 minutes 3 seconds

Experimental conditions.

Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	2600 MHz
Signal	CW
Frequency (MHz)	2600.000000
Relative permittivity (real part)	38.097251
Conductivity (S/m)	1.978736
Power drift (%)	-0.050000
Ambient Temperature:	21.8°C
Liquid Temperature:	21.2°C
ConvF:	2.36
Crest factor:	1:1



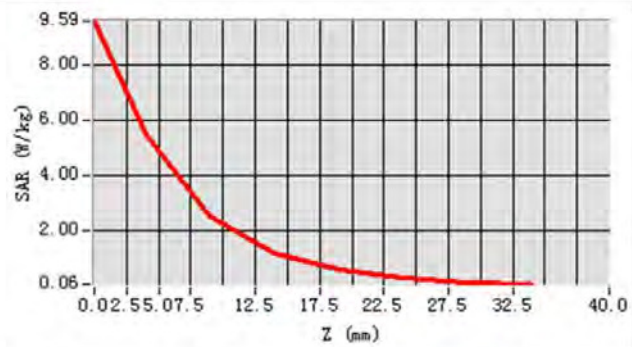


Maximum location: X=0.00, Y=0.00

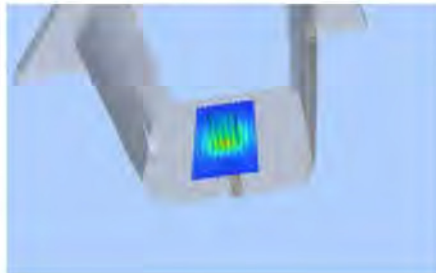
SAR Peak: 9.58 W/kg

SAR 10 g (W/Kg)	2.514654
SAR 1 g (W/Kg)	5.322832

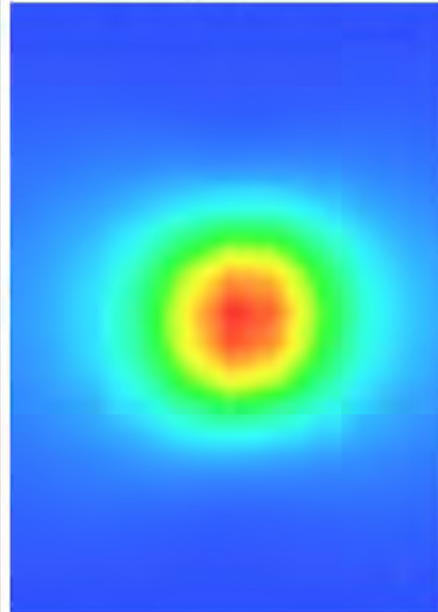
Z Axis Scan



3D screen shot



Hot spot position





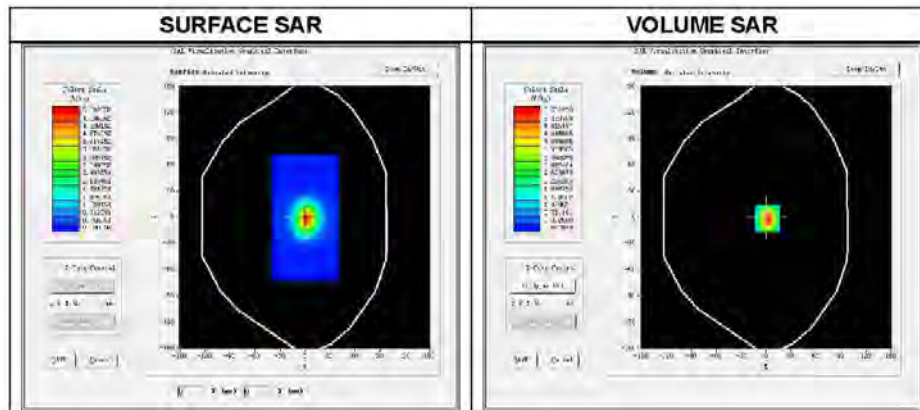
5.10.2 Dipole 2600 MHz Validation Measurement for Body Tissue

System Performance Check Data(2600 MHz Body)

Type: Phone measurement (Complete)
E-Field Probe: SN 34/15 SSE2 EPGO265
Area scan resolution: dx=8 mm,dy=8 mm
Zoom scan resolution: dx=5 mm, dy=5 mm, dz=5 mm
Date of measurement: 2016.03.03
Measurement duration: 19 minutes 1 seconds

Experimental conditions.

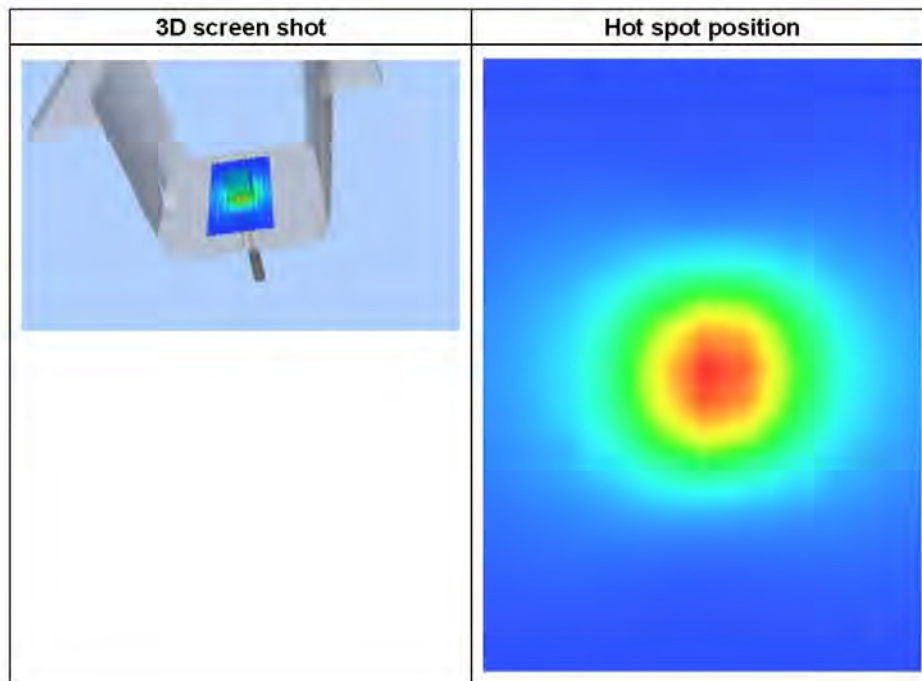
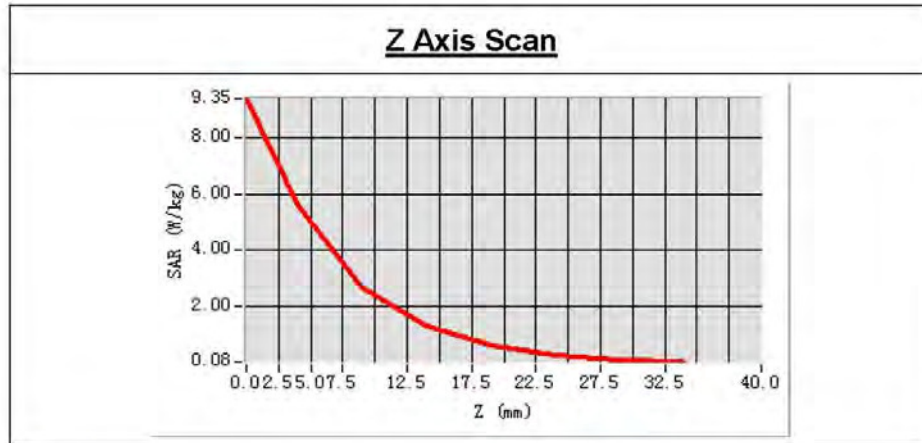
Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	2600 MHz
Signal	CW
Frequency (MHz)	2600.000000
Relative permittivity (real part)	53.509271
Conductivity (S/m)	2.150646
Power drift (%)	0.180000
Ambient Temperature:	21.8°C
Liquid Temperature:	21.2°C
ConvF:	2.43
Crest factor:	1:1





Maximum location: X=0.00, Y=0.00
SAR Peak: 9.36 W/kg

SAR 10 g (W/Kg)	2.376986
SAR 1 g (W/Kg)	5.174332





5.11 SWG5500

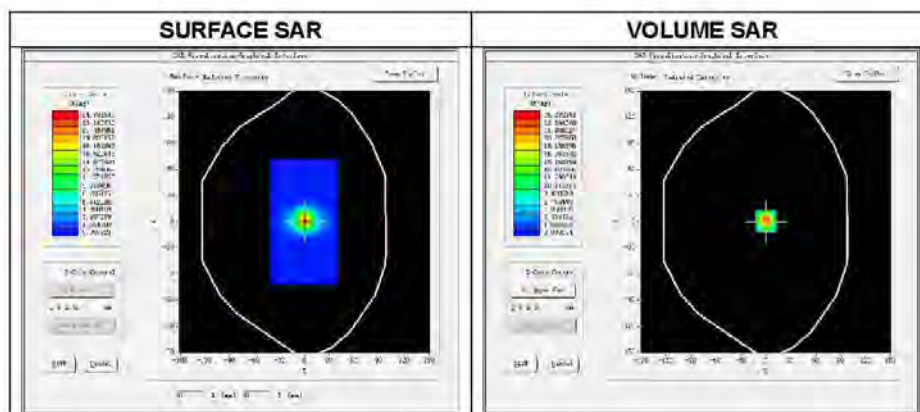
5.11.1 Waveguide 5 GHz Validation Measurement for Head Tissue

System Performance Check Data(5200 MHz Head)

Type: Phone measurement (Complete)
 E-Field Probe: SN 34/15 SSE2 EPGO265
 Area scan resolution: dx=8mm,dy=8mm
 Zoom scan resolution: dx=4mm, dy=4mm, dz=2mm
 Date of measurement: 2016.03.03
 Measurement duration: 29 minutes 32 seconds

Experimental conditions.

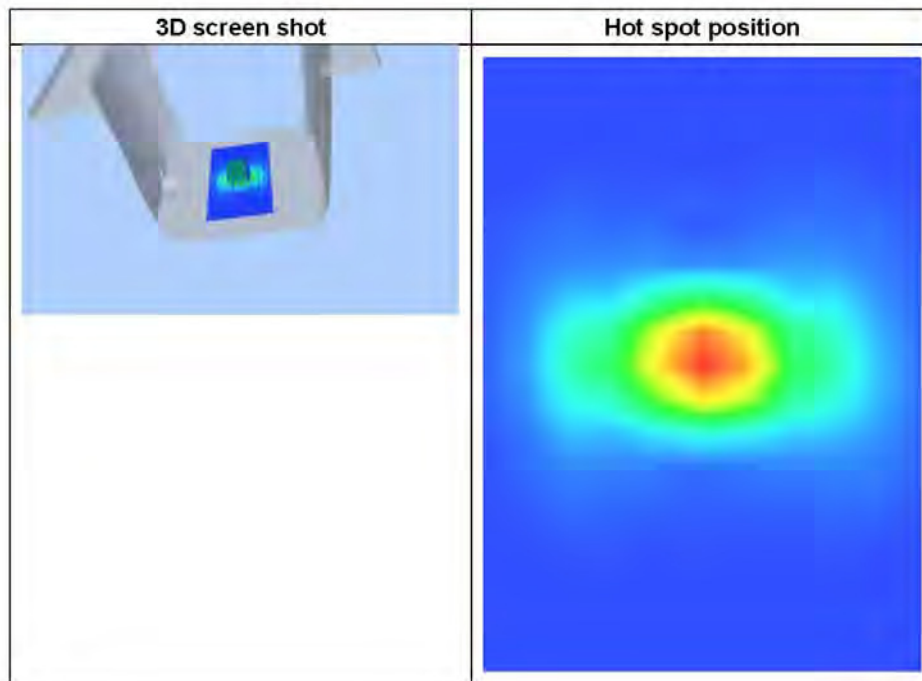
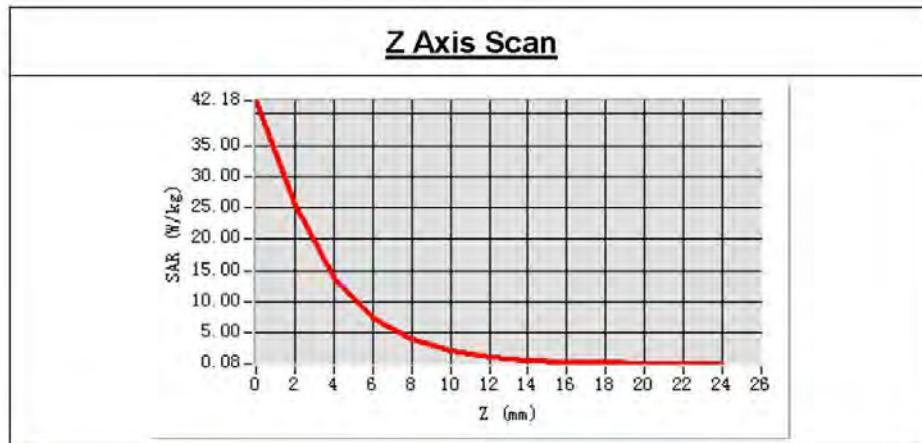
Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	5200 MHz
Signal	CW
Frequency (MHz)	5200.000000
Relative permittivity (real part)	36.867518
Conductivity (S/m)	4.644428
Power drift (%)	1.570000
Ambient Temperature:	21.5°C
Liquid Temperature:	21.0°C
ConvF:	1.81
Crest factor:	1:1





Maximum location: X=3.00, Y=1.00
SAR Peak: 42.15 W/kg

SAR 10g (W/Kg)	5.4633244
SAR 1g (W/Kg)	15.378286



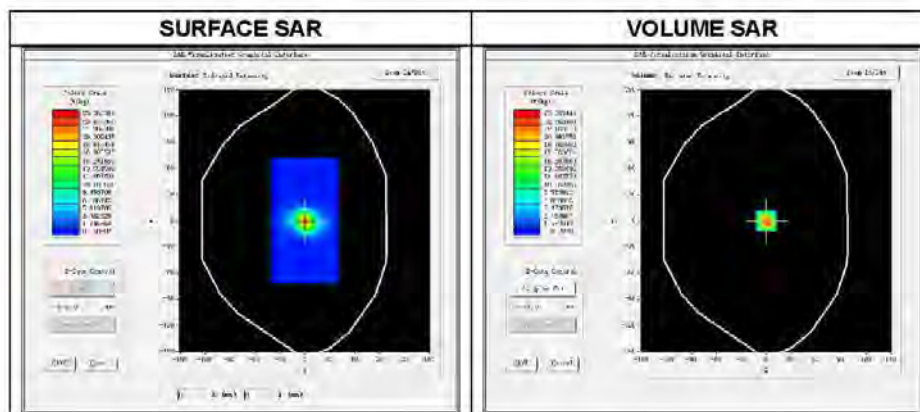


System Performance Check Data(5400 MHz Head)

Type: Phone measurement (Complete)
E-Field Probe: SN 34/15 SSE2 EPGO265
Area scan resolution: dx=8mm,dy=8mm
Zoom scan resolution: dx=4mm, dy=4mm, dz=2mm
Date of measurement: 2016.03.03
Measurement duration: 29 minutes 33 seconds

Experimental conditions.

Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	5400 MHz
Signal	CW
Frequency (MHz)	5400.000000
Relative permittivity (real part)	36.426257
Conductivity (S/m)	4.831236
Power drift (%)	1.120000
Ambient Temperature:	21.5°C
Liquid Temperature:	21.0°C
ConvF:	2.04
Crest factor:	1:1

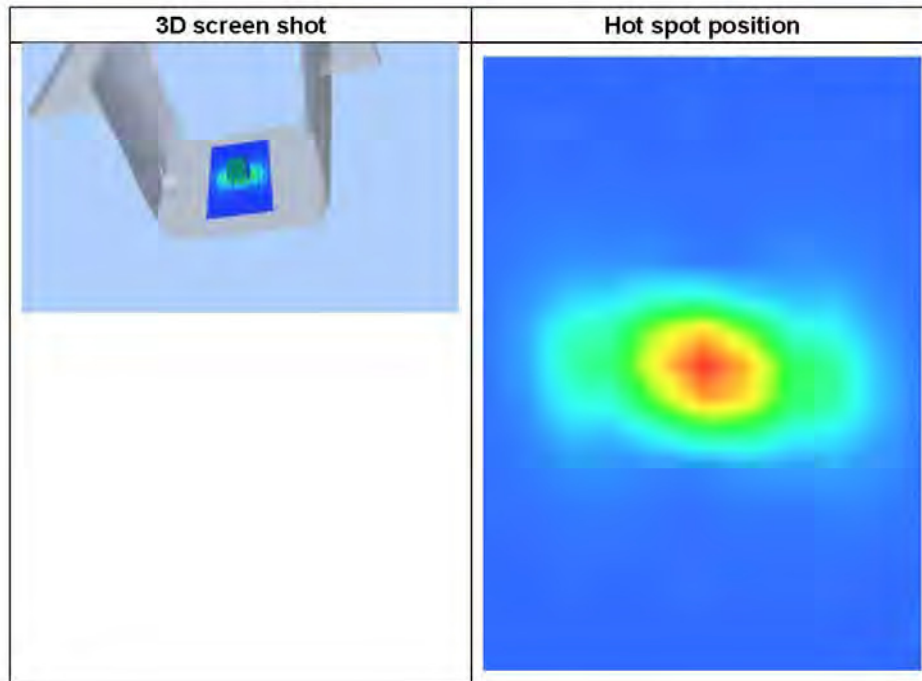
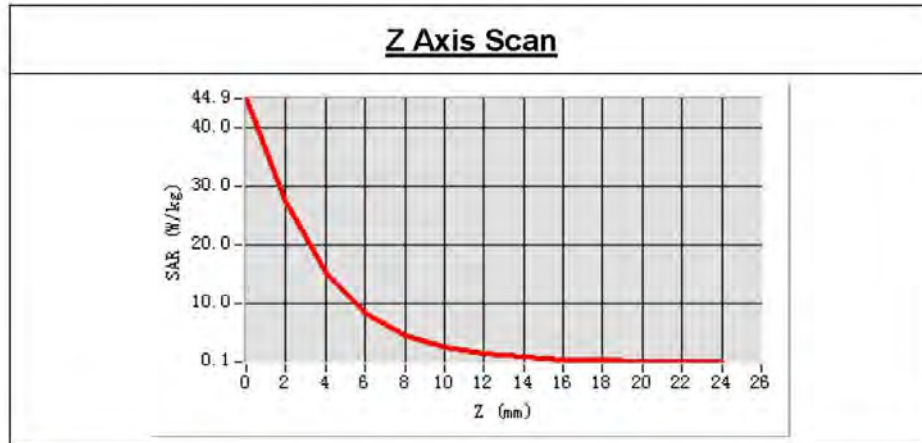




Maximum location: X=0.00, Y=0.00

SAR Peak: 44.03 W/kg

SAR 10g (W/Kg)	5.517354
SAR 1g (W/Kg)	15.876169



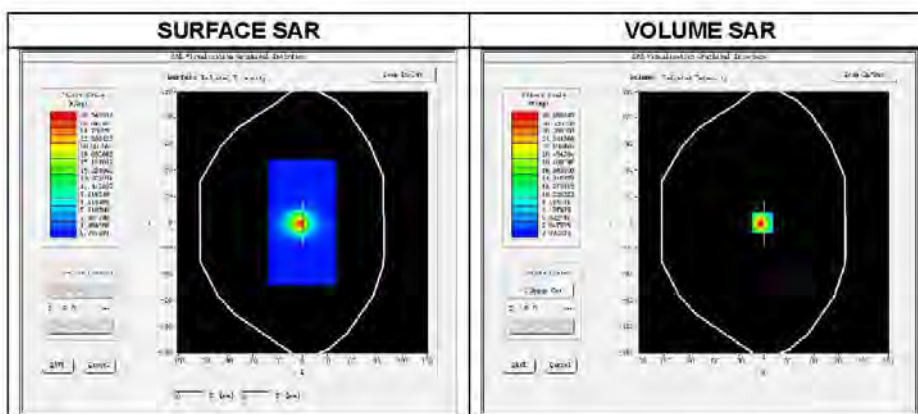


System Performance Check Data(5600 MHz Head)

Type: Phone measurement (Complete)
E-Field Probe: SN 34/15 SSE2 EPGO265
Area scan resolution: dx=8mm,dy=8mm
Zoom scan resolution: dx=4mm, dy=4mm, dz=2mm
Date of measurement: 2016.03.03
Measurement duration: 29 minutes 30 seconds

Experimental conditions.

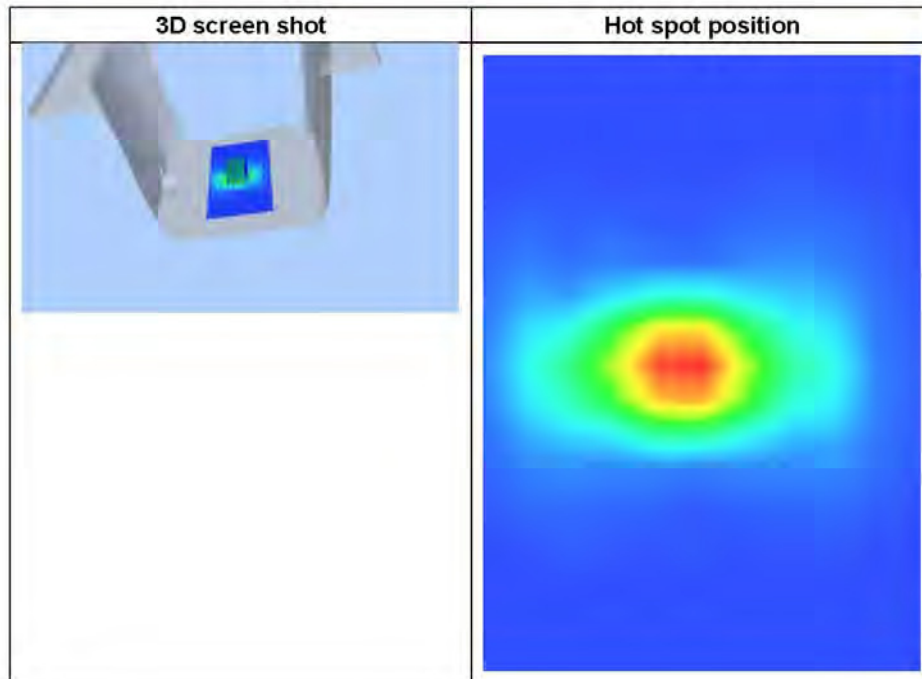
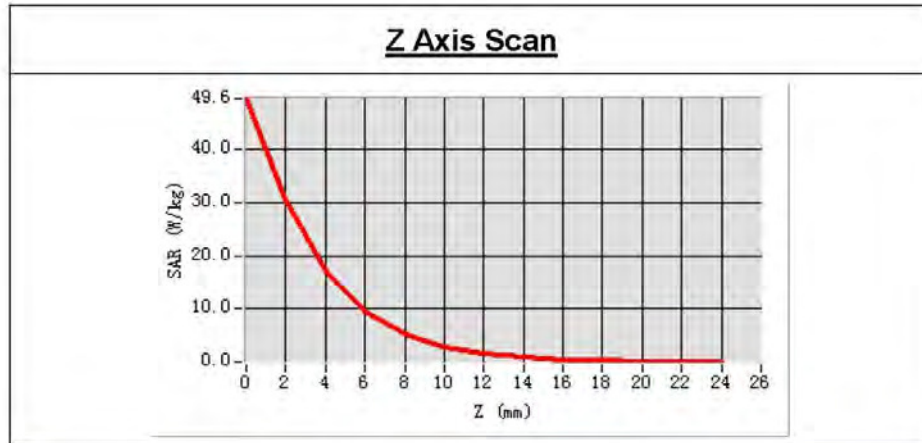
Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	5600 MHz
Signal	CW
Frequency (MHz)	5600.000000
Relative permittivity (real part)	34.462351
Conductivity (S/m)	5.137525
Power drift (%)	0.800000
Ambient Temperature:	21.5°C
Liquid Temperature:	21.0°C
ConvF:	2.08
Crest factor:	1:1





Maximum location: X=1.00, Y=1.00
SAR Peak: 49.52 W/kg

SAR 10g (W/Kg)	5.791756
SAR 1g (W/Kg)	16.475376



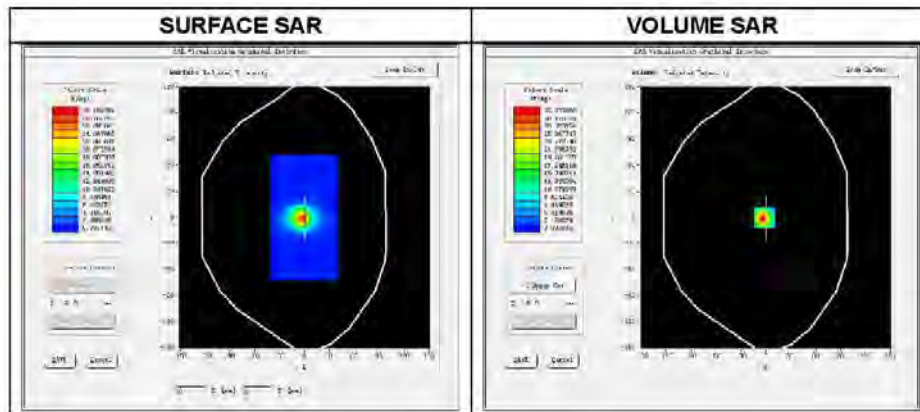


System Performance Check Data(5800 MHz Head)

Type: Phone measurement (Complete)
E-Field Probe: SN 34/15 SSE2 EPG0265
Area scan resolution: dx=8mm,dy=8mm
Zoom scan resolution: dx=4mm, dy=4mm, dz=2mm
Date of measurement: 2016.03.03
Measurement duration: 29 minutes 31 seconds

Experimental conditions.

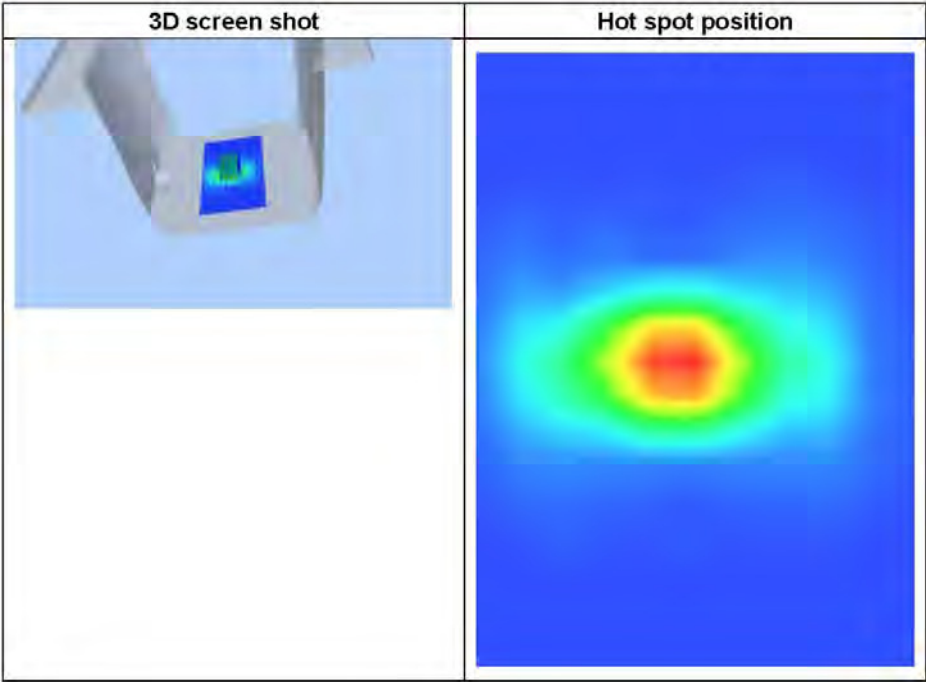
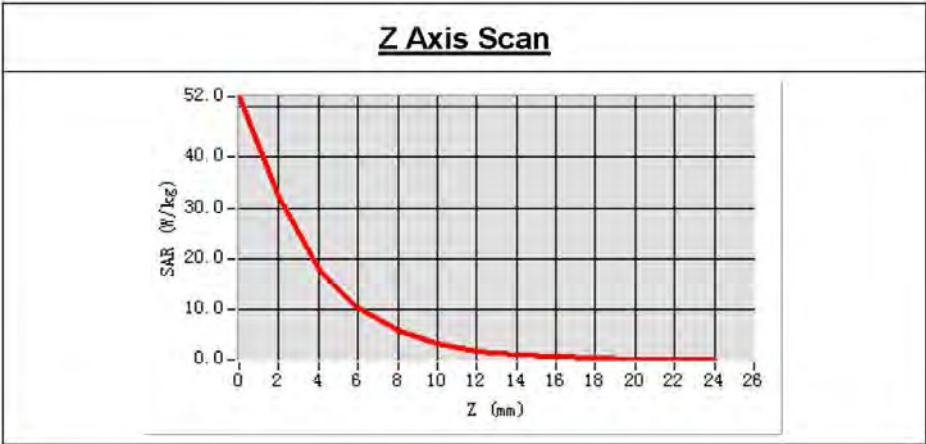
Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	5800 MHz
Signal	CW
Frequency (MHz)	5800.000000
Relative permittivity (real part)	34.327163
Conductivity (S/m)	5.305872
Power drift (%)	1.660000
Ambient Temperature:	21.5°C
Liquid Temperature:	21.0°C
ConvF:	1.88
Crest factor:	1:1





Maximum location: X=0.00, Y=0.00
SAR Peak: 51.16 W/kg

SAR 10g (W/Kg)	5.983526
SAR 1g (W/Kg)	17.687528





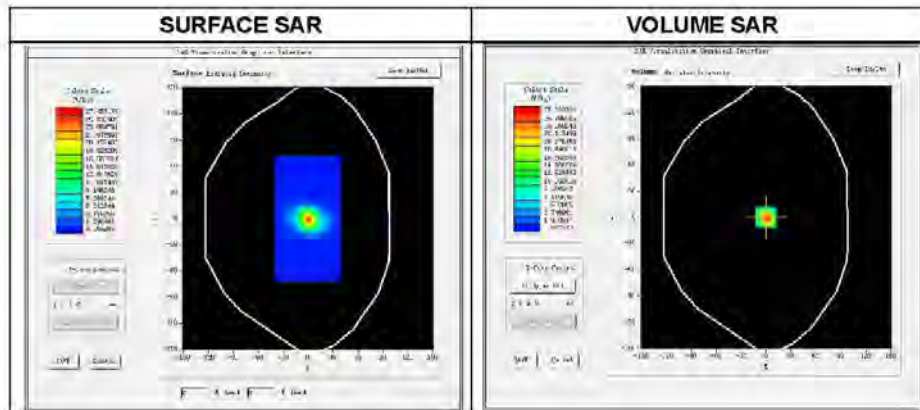
5.11.2 Waveguide 5 GHz Validation Measurement for Body Tissue

System Performance Check Data(5200MHz Body)

Type: Phone measurement (Complete)
 E-Field Probe: SN 34/15 SSE2 EPG0265
 Area scan resolution: dx=8mm,dy=8mm
 Zoom scan resolution: dx=4mm, dy=4mm, dz=2mm
 Date of measurement: 2016.03.03
 Measurement duration: 29 minutes 32 seconds

Experimental conditions.

Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	5200 MHz
Signal	CW
Frequency (MHz)	5200.000000
Relative permittivity (real part)	50.126533
Conductivity (S/m)	5.256854
Power drift (%)	2.320000
Ambient Temperature:	21.5°C
Liquid Temperature:	21.0°C
ConvF:	1.85
Crest factor:	1:1



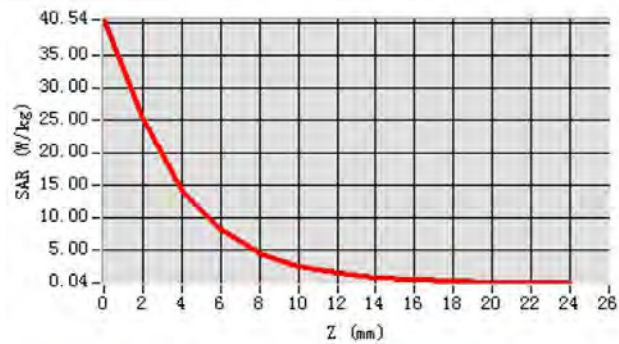


Maximum location: X=0.00, Y=0.00

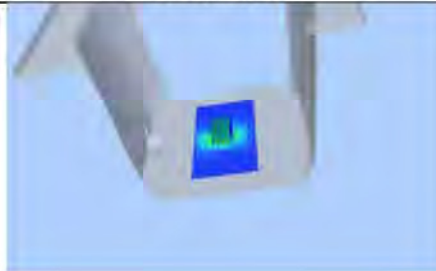
SAR Peak: 40.51 W/kg

SAR 10g (W/Kg)	5.340976
SAR 1g (W/Kg)	15.223962

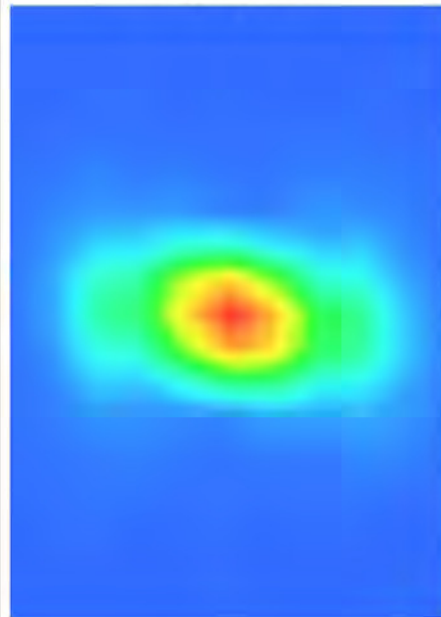
Z Axis Scan



3D screen shot



Hot spot position



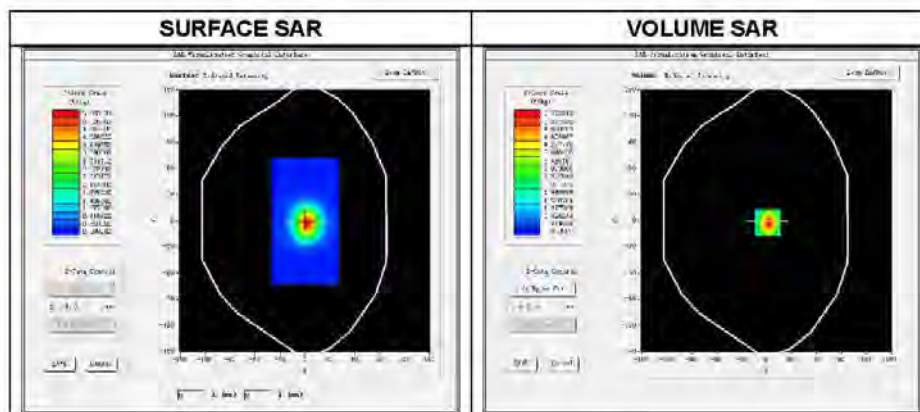


System Performance Check Data (5400 MHz Body)

Type: Phone measurement (Complete)
E-Field Probe: SN 34/15 SSE2 EPGO265
Area scan resolution: dx=8mm,dy=8mm
Zoom scan resolution: dx=4mm, dy=4mm, dz=2mm
Date of measurement: 2016.03.03
Measurement duration: 29 minutes 32 seconds

Experimental conditions.

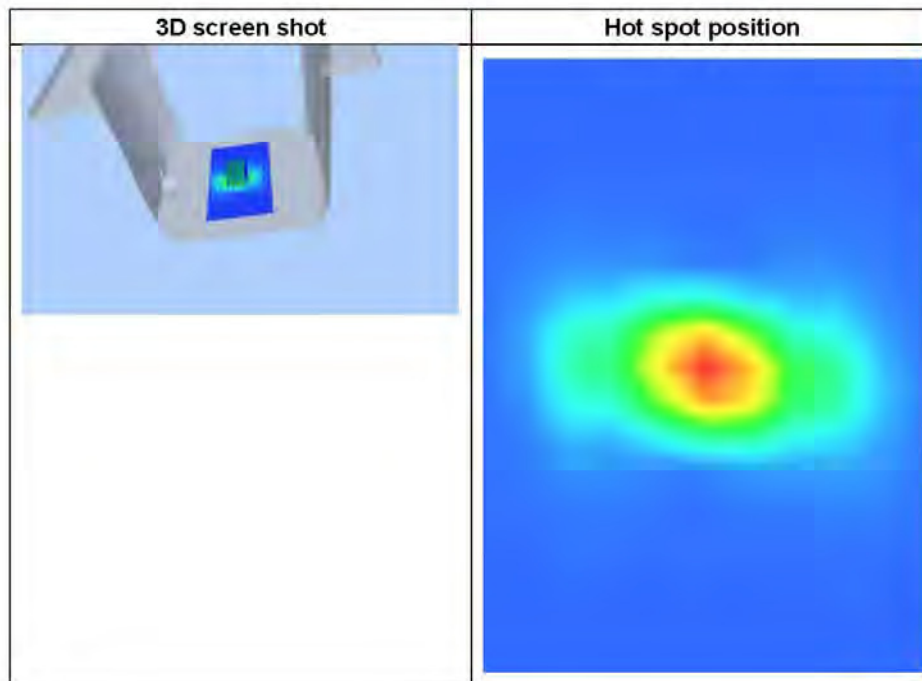
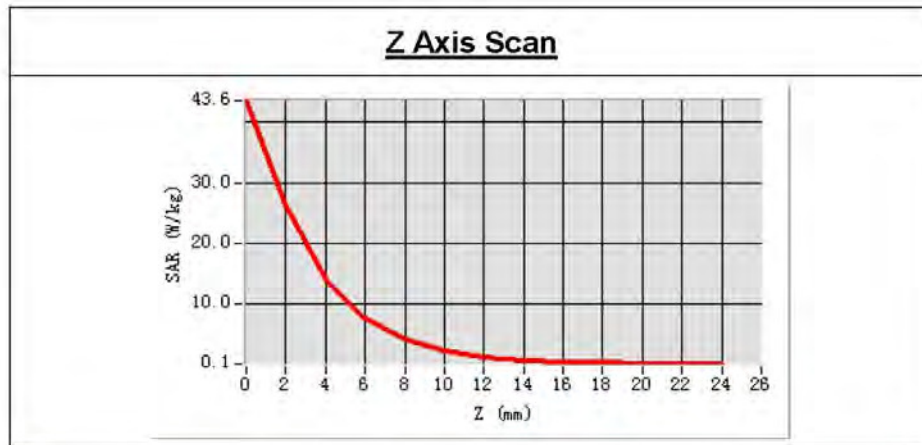
Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	5400 MHz
Signal	CW
Frequency (MHz)	5400.000000
Relative permittivity (real part)	50.016325
Conductivity (S/m)	5.513862
Power drift (%)	1.160000
Ambient Temperature:	21.5°C
Liquid Temperature:	21.0°C
ConvF:	2.11
Crest factor:	1:1





Maximum location: X=0.00, Y=0.00
SAR Peak: 43.26 W/kg

SAR 10g (W/Kg)	5.615362
SAR 1g (W/Kg)	15.762167



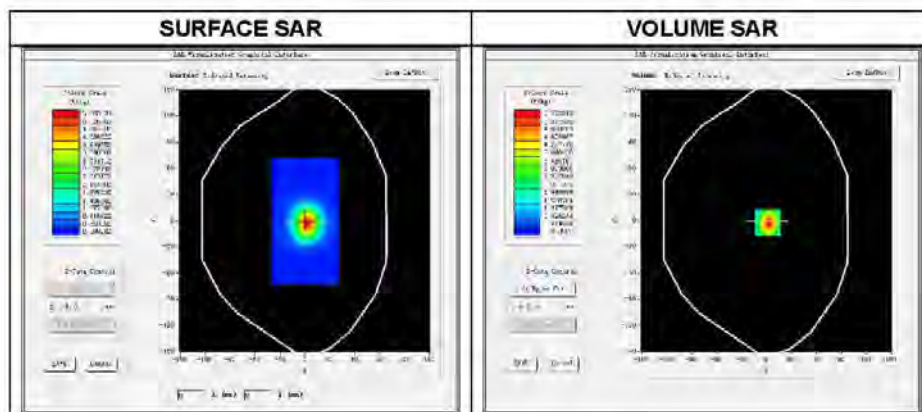


System Performance Check Data (5600 MHz Body)

Type: Phone measurement (Complete)
E-Field Probe: SN 34/15 SSE2 EPGO265
Area scan resolution: dx=8mm,dy=8mm
Zoom scan resolution: dx=4mm, dy=4mm, dz=2mm
Date of measurement: 2016.03.03
Measurement duration: 29 minutes 32 seconds

Experimental conditions.

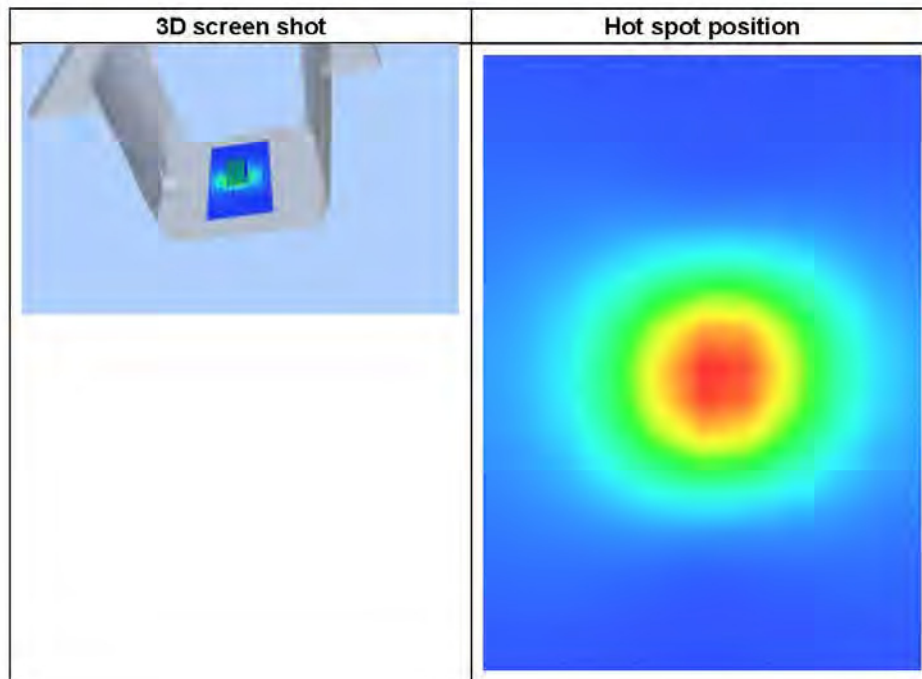
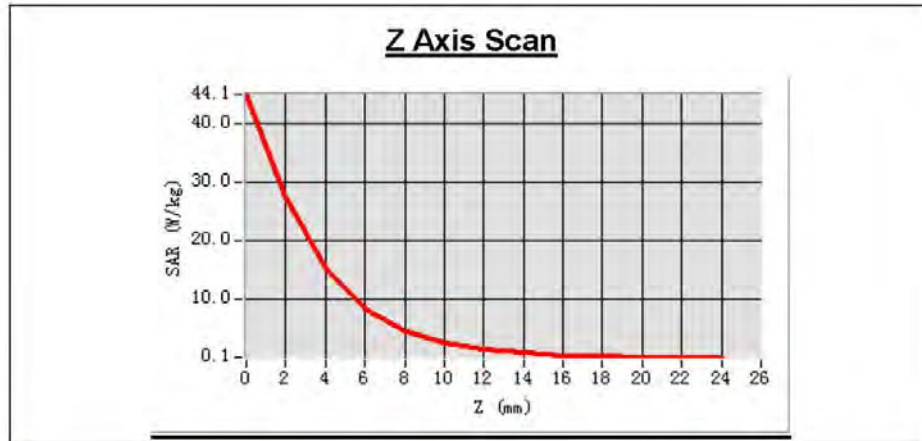
Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	5600 MHz
Signal	CW
Frequency (MHz)	5600.000000
Relative permittivity (real part)	48.041782
Conductivity (S/m)	5.932687
Power drift (%)	2.130000
Ambient Temperature:	21.5°C
Liquid Temperature:	21.0°C
ConvF:	2.15
Crest factor:	1:1





Maximum location: X=0.00, Y=0.00
SAR Peak: 52.10W/kg

SAR 10g (W/Kg)	5.645281
SAR 1g (W/Kg)	15.812583



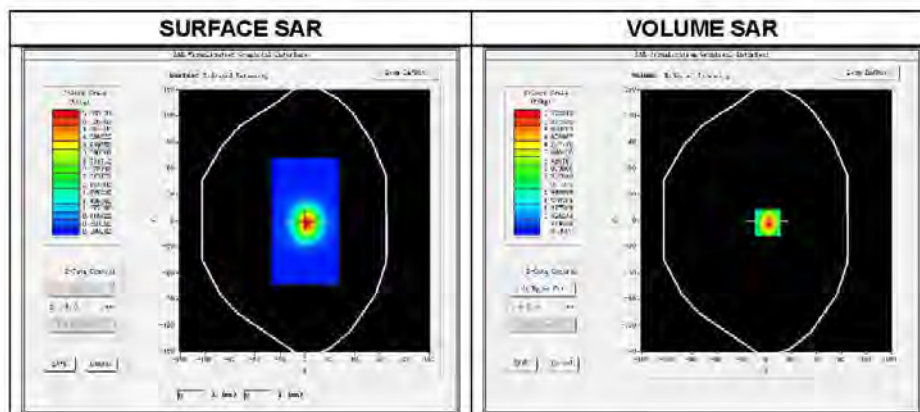


System Performance Check Data (5800 MHz Body)

Type: Phone measurement (Complete)
E-Field Probe: SN 34/15 SSE2 EPGO265
Area scan resolution: dx=8mm,dy=8mm
Zoom scan resolution: dx=4mm, dy=4mm, dz=2mm
Date of measurement: 2016.03.03
Measurement duration: 29 minutes 32 seconds

Experimental conditions.

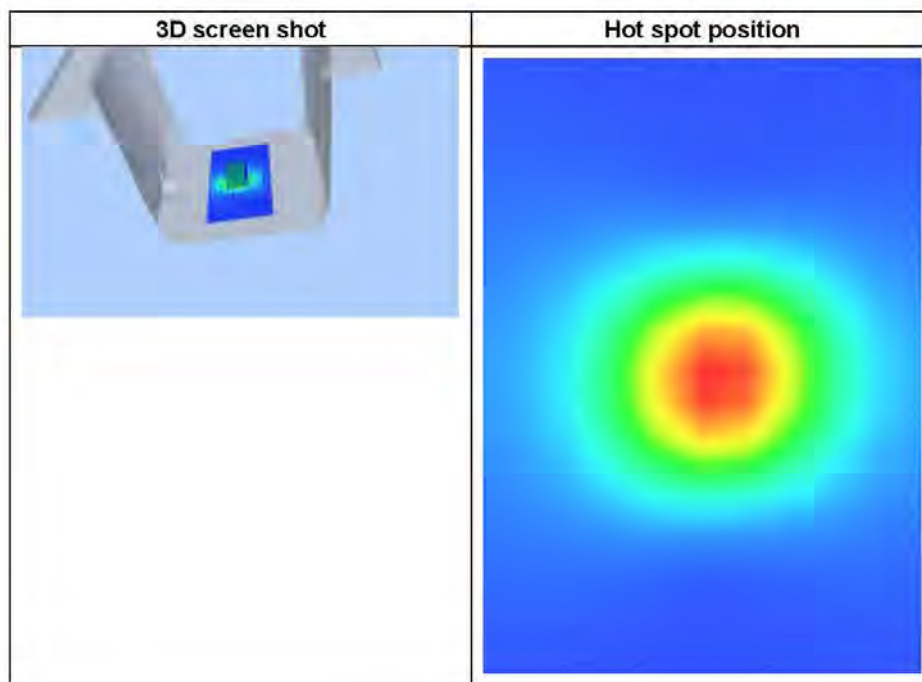
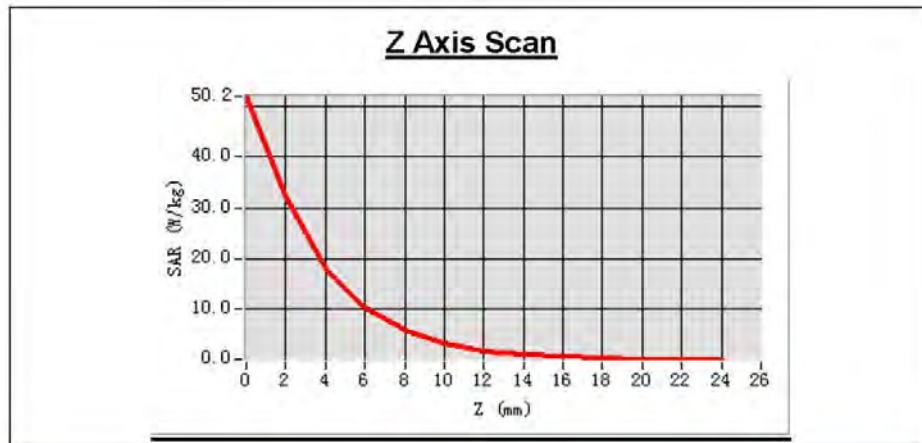
Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Band	5800 MHz
Signal	CW
Frequency (MHz)	5800.000000
Relative permittivity (real part)	47.135215
Conductivity (S/m)	6.071259
Power drift (%)	2.130000
Ambient Temperature:	21.5°C
Liquid Temperature:	21.0°C
ConvF:	1.93
Crest factor:	1:1





Maximum location: X=0.00, Y=0.00
SAR Peak: 50.10W/kg

SAR 10g (W/Kg)	5.836267
SAR 1g (W/Kg)	16.942574



--END OF REPORT--